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Interventions and Management

1. The Impact of Task-Oriented Training on Hand Functionality in Children with Cerebral Palsy under 18 Years: A Systematic Review and Meta-Analysis

Yuxin Xiao, Jun Zhang, Yongfu Liu, Xiaoyan Chen, Ruifeng Wu, Shenglong Le, Wei Fan, Le Zhao, Feng Gao

Front Neurol. 2026 Mar 5;17:1775810.

Objective: To evaluate the effectiveness of task-oriented training on hand dysfunction in children with cerebral palsy. **Methods:** Randomized controlled trials comparing task-oriented training plus standard rehabilitation with standard rehabilitation alone were identified through comprehensive database searches. Meta-analysis was performed to synthesize outcomes related to hand function, grip strength, cognitive ability, and functional independence. **Results:** Sixteen studies involving 1,037 children were included. Task-oriented training significantly improved hand function compared with control interventions. Improvements were also observed in grip strength, cognitive ability, and functional independence. **Conclusion:** Task-oriented training is effective in improving hand dexterity and functional outcomes in children with cerebral palsy. Larger, high-quality trials are needed to confirm findings across all outcome domains.
PMID: [41868489](#)

2. Hip Reconstruction in Children with Cerebral Palsy: Comparing Treatment Plans Derived from Pelvic Radiographs Versus Those from Hip CTs

Andy Tsai, Patrick Johnston, Benjamin J Shore

J Clin Med. 2026 Mar 16;15(6):2259.

Background/Objectives: Hip displacement is a common problem in children with cerebral palsy (CP). Typically, hip surveillance imaging consists of an anteroposterior pelvic radiograph from which migration percentage (MP) is calculated to determine treatment plans. However, little is known about the accuracy of MP for treatment planning. This study aimed to compare treatment plans based on MP thresholds with plans determined by an orthopedic surgeon after review of hip CTs. **Methods:** Hip CTs performed in children with CP aged ≤ 18 years between November 2018 and July 2024 were retrospectively identified. Inclusion criteria were a pelvic radiograph performed within 6 months prior to the hip CT and no surgeries between imaging studies. CTs were randomized and blindly reviewed by an orthopedic surgeon to determine treatment plans, while pelvic radiographs were blindly reviewed by a pediatric radiologist to calculate MP-based treatment plans. Agreement was assessed using kappa statistics and Bland–Altman analyses. **Results:** The cohort included 139 children (mean age 9.3 ± 3.8 years; 90 males) with 278 hips. Agreement between CT- and radiograph-based treatment plans was low (proportion agreement 0.532; unweighted kappa 0.339). Bland–Altman analysis showed the approaches were exchangeable when $MP \leq 10\%$ but not at higher values. **Conclusions:** Reliance solely on pelvic radiographs and MP calculations may be insufficient for treatment decision-making in hip displacement among children with CP, as important anatomical details are better appreciated on 3D imaging.
PMID: [41899184](#)

3.Potential Predictors of Hip Surgery Following Selective Dorsal Rhizotomy in Children with Cerebral Palsy: Survival Analysis of a Retrospective Cohort

Kellen T Krajewski, Jessica L Stockhausen, Scott C Miller, Patrick M Carry, Joyce L Oleszek, Sayan De

PM R. 2026 Mar 27. Online ahead of print.

Background: Neuromuscular hip dysplasia is a prevalent sequela in children with cerebral palsy (CP) that often requires orthopedic intervention. Selective dorsal rhizotomy (SDR) reduces spasticity, but some individuals still require hip surgery following SDR, and contributing factors are not well understood. Objective: To determine factors influencing the need for hip surgery following SDR in children with CP. Methods: A retrospective cohort of children with CP who underwent SDR was analyzed. The primary outcome was incidence of hip surgery. Demographic, clinical, and radiographic variables were collected, including acetabular index (AI), migration index, neck–shaft angle, and SDR surgical parameters. Multivariable Cox proportional hazards modeling and receiver operating characteristic analyses were performed. Results: Sixty-eight patients (135 hips) were included, with 16 patients requiring hip surgery a mean of 3.0 years after SDR. Higher AI significantly increased risk of hip surgery (hazard ratio 1.36, 95% CI 1.22–1.51). An AI cutoff of 23° demonstrated moderate sensitivity and high specificity for predicting surgery. Conclusion: Children with CP and an acetabular index $\geq 23^\circ$ at the time of SDR are at increased risk for subsequent hip surgery, independent of age and sex. AI may be a valuable factor for counseling and shared decision-making before SDR.

PMID: [41891666](#)

4.Factors Affecting Mobility in the Transition Period from Childhood to Adolescence in Cerebral Palsy: A Prospective Longitudinal Study

Hsiu-Ching Chiu, Louise Ada, Chieh-feng Chen

Physiotherapy. 2026 Feb 24;132:102314.

Objective: To investigate changes in mobility and factors affecting mobility over a two-year period from childhood to adolescence in children with cerebral palsy. Methods: A multi-site prospective longitudinal cohort study was conducted with 75 children with cerebral palsy aged approximately 11 years at baseline. Measures included sensory and motor impairments and mobility outcomes assessed at baseline, one year, and two years. Stepwise multiple regression was used to examine associations between changes in impairments and mobility. Results: Overall mobility increased over two years, accompanied by improvements in coordination and strength, while spasticity, contracture, and sensation remained unchanged. Change in strength and coordination accounted for 20% of the variance in change in the 6-minute walk test. Conclusions: Mobility improved during pre-adolescence in children with cerebral palsy and was associated with increased muscle strength and coordination, highlighting key targets for intervention during this transition period.

PMID: [41880815](#)

5. Morphological and Biochemical Abnormalities of Gracilis Muscle from Children with Cerebral Palsy

Vadim Evreinov, Maksim Stogov, Elena Kireeva, Galina Filimonova, Tatyana Zhironova, Margarita Alisa Popkova, Dmitry Popkov

J Funct Morphol Kinesiol. 2026 Feb 22;11(1):90.

Background: Developing an evidence base for physiotherapy programs for patients with Cerebral Palsy (CP) requires an understanding of the microscopic and metabolic processes in striated muscle. The gracilis muscle represents a logical object of study due to the significant morphological changes in individuals with cerebral palsy. This research aims to study morphological and biochemical alterations in the gracilis muscle depending on the severity of motor impairments in CP patients. **Methods:** The cross-sectional study included 24 patients stratified by the severity of motor impairment. Intraoperative gracilis muscle samples were obtained during tenomyotomies. Nutritional status of patients, morphometric, and biochemical parameters were evaluated. **Results:** Initial body mass and Quetelet index ($p = 0.02$) were lower in GMFCS V patients ($p = 0.01$) compared to GMFCS IV and GMFCS II-III. Muscle tissue predominated in histological samples of GMFCS II-III and GMFCS V patients ($p = 0.79$), while connective tissue content was higher in the GMFCS IV group ($p = 0.03$). Strong, fast-twitch, anaerobic fibers ($p = 0.761$) with reduced creatine phosphokinase activity ($p = 0.012$) were more frequently observed in the intraoperative samples of GMFCS V patients. Low creatine phosphokinase activity was revealed in children in the GMFCS V group ($p = 0.012$). **Conclusions:** The structural and metabolic abnormalities observed in gracilis muscle of patients with spastic cerebral palsy indicates profound functional muscular dysfunction, representing one of the factors limiting children's motor ability. The morphological and biochemical alterations in the striated muscle of CP children correlate with severity of motor dysfunction conditioned by the primary upper motor neuron disorders. Less significant changes in muscles in ambulatory children reflect favorable basis for physical therapy.

PMID: [41900497](#)

6. Foot Weight-Bearing in Supported Standing: Influence of Verticalization Angles and Hip/Knee Flexion in Children and Adolescents with Cerebral Palsy (GMFCS IV–V)

Eva M Steindl, René Althaus

Children (Basel). 2026 Feb 27;13(3):346.

Background: Supported standing is commonly prescribed for children and adolescents with cerebral palsy (CP) to promote musculoskeletal health, yet objective data on plantar loading under different positioning conditions are limited, particularly in individuals with severe motor impairment. This study quantified plantar loading during supported standing across varying verticalization and hip/knee flexion angles. **Methods:** Twenty-six children and adolescents with CP (GMFCS IV–V) were assessed using a standardized back-supported standing system. Plantar loading was measured with force plates across six verticalization angles combined with four hip/knee flexion angles and expressed as a percentage of body weight. **Results:** Plantar loading increased progressively with greater verticalization angles across all flexion conditions. Clinically meaningful loading levels were achieved at moderate verticalization angles. Maximum loading occurred at full verticalization with moderate hip/knee flexion. Only extreme flexion substantially reduced plantar loading. **Conclusions:** Verticalization angle is the primary determinant of plantar loading during supported standing in children and adolescents with severe CP. Effective foot weight-bearing can be achieved at moderate verticalization angles despite hip and knee flexion, supporting flexible positioning strategies.

PMID: [41897059](#)

7. Augmented Feedback as a Therapeutic Approach for Gait Rehabilitation in Patients with Cerebral Palsy: A Systematic Review

Leonie Hirsch, Natalie Mrachacz-Kersting

Front Rehabil Sci. 2026 Mar 11;7:1638091.

Objectives: To evaluate the effectiveness of augmented feedback in improving gait function in individuals with cerebral palsy and to assess the strength of evidence across gait parameters. **Eligibility criteria:** Interventional studies involving children or adults with cerebral palsy receiving augmented feedback during gait training were included. **Information sources:** PubMed, Cochrane Library, IEEE Xplore, and PEDro were searched. **Risk of bias:** Risk of bias was assessed using Cochrane and MINORS tools. **Results:** Twenty-five studies including 612 participants were analyzed. Strong evidence supported improvements in gait velocity, while ankle kinematics showed moderate to strong evidence. Visual feedback produced the most consistent effects. Evidence for other gait parameters was inconclusive due to heterogeneous and conflicting findings. **Interpretation:** Augmented feedback shows promise for improving gait velocity and ankle function in cerebral palsy, particularly in spastic subtypes. However, heterogeneity and limited long-term data limit firm clinical recommendations. PMID: [41891113](#)

8. Effectiveness of Therapeutic Exercise Programs on Balance and Gait in Children and Adolescents with Unilateral Cerebral Palsy: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

María Martínez-Olagüe Jácome, Patricia Domínguez-López, Raquel Rodrigo-Masanet, Rocío Palomo-Carrión, Purificación López-Muñoz, María Coello-Villalón

Clin Rehabil. 2026 Mar 25. Online ahead of print.

Objective: Unilateral cerebral palsy causes motor impairments that compromise balance and gait. This systematic review evaluated the effects of therapeutic exercise programs on balance and gait in children and adolescents with unilateral cerebral palsy. **Methods:** Randomized controlled trials involving participants aged 2–18 years were identified through searches of multiple databases. Standardized mean differences were pooled using random-effects models, with subgroup, sensitivity, and meta-regression analyses conducted. **Results:** Thirteen trials were included. Exercise programs produced a significant moderate effect on balance, while the effect on gait was moderate but not statistically significant and demonstrated high heterogeneity. Subgroup analyses suggested differential effects depending on training type, and a dose–response relationship was identified for balance outcomes. **Conclusion:** Therapeutic exercise programs improve balance in children and adolescents with unilateral cerebral palsy. Effects on gait remain uncertain, supporting the integration of structured balance-focused interventions into rehabilitation programs. PMID: [41879099](#)

9. Experimental Investigation of Muscle-Tendon Unit Geometry and Kinematics in Lower-Limb Muscles during Gait: Current Applications and Future Directions – A Scoping Review

Thomas Lecharte, Fabien Leboeuf, Raphaël Gross, Antoine Nordez, Guillaume Le Sant, Cloé Dussault-Picard

Gait Posture. 2026 Mar 15;127:110159.

Purpose: Musculoskeletal modeling and ultrasound imaging are complementary techniques that can be combined with three-dimensional gait analysis to assess muscle and muscle–tendon unit characteristics during gait. This scoping review examined how these methods are used in populations with neuromotor impairments and explored their clinical implications. **Results:** Fifty studies were identified, including populations with cerebral palsy, stroke, hereditary spastic paraparesis, and idiopathic toe walking. Both approaches enabled assessment of muscle and muscle–tendon unit length during gait, while musculoskeletal modeling additionally allowed analysis of lengthening velocity, intervention effects, and predictors of surgical outcomes. Each method demonstrated specific limitations related to modeling assumptions or data acquisition challenges. **Conclusions:** Musculoskeletal modeling and ultrasound imaging provide complementary information when combined with gait analysis and offer potential to support personalized clinical decision-making. Further research should expand to additional neuromotor conditions and explore automated analysis methods to enhance clinical applicability. PMID: [41875704](#)

10. Exploring the Relationship Between Physical Activity and ICF Domains in Young Adults with Cerebral Palsy: A Comparison of Unilateral and Bilateral Cases

Lena Carcreff, Anne Tabard-Fougère, Geraldo De Coulon, Stéphane Armand, Alice Bonnefoy-Mazure

J Clin Med. 2026 Mar 20;15(6):2391.

Background/Objectives: Youths with cerebral palsy (CP) have reduced levels of physical activity (PA) due to motor impairments and functional difficulties. Few studies have observed its link with various factors and none in young adults with CP. This study aimed to investigate the relationships between PA and various factors in young adults with CP, such as gait function, endurance, participation, and personal/environmental influences. **Methods:** Participants over 15 years old with CP who underwent Clinical Gait Analysis (CGA), the 6 min walk test, and wore an actimeter (ActiGraph GT3X+) for seven days were included. PA was assessed by daily step count (NbSteps/day). Explanatory factors included the Gait Profile Score (GPS), walking speed, subjective walking perception, joint pain, fatigue, 6 min walk distance, SF-36 questionnaire scores, and lifestyle habits. Correlations, univariate, and multivariate regression models were used for the analysis. **Results:** Forty-seven CP patients (28 males, 19 females, mean age 23.6 years) were included, with 82% classified as GMFCS I and 18% as GMFCS II. The average NbSteps/day was 5685. Significant correlations were found between NbSteps/day and subjective perception, pain, GMFCS level, and walking speed. Multivariate regression identified walking speed and physiotherapy sessions as significant predictors of PA. **Conclusions:** PA in young adults with CP is linked to walking speed, GMFCS level, joint pain, fatigue, and physiotherapy. No differences have been observed between unilateral or bilateral CP. However, individual behaviors vary and are not fully explained by linear regression analysis.

PMID: [41899314](#)

11. Influence of Immobilization, Stretching, and Activity on the Morphological Properties of Spastic Gastrocnemius Muscles

Andreas Habersack, Annika Kruse, Bernhard Guggenberger, Nina Mosser, Markus Tilp, Martin Svehlik

Children (Basel). 2026 Mar 18;13(3):414.

Background/Objectives: Children with cerebral palsy (CP) often develop altered muscle architecture and calf muscle contractures. Orthotic immobilization aims to provide prolonged stretch to lengthen the muscle belly and muscle-tendon unit (MTU), but immobilization may also cause atrophy. This study investigated whether immobilization combined with periods of daily muscle activation has a different effect on calf muscle properties than continuous immobilization alone. **Methods:** Fourteen children with CP and equinus deformity were enrolled in a 12-week randomized controlled trial and allocated to either continuous immobilization with a dynamic ankle-foot orthosis or a combined regimen of immobilization and daily activity. Gastrocnemius medialis MTU properties, including muscle belly length, Achilles tendon length, fascicle length, and muscle volume, were assessed at four time points using three-dimensional freehand ultrasound. **Results:** Significant within-group increases in MTU and Achilles tendon lengths were observed over time at both neutral and dorsiflexed ankle positions. No significant group × time interactions were observed for any parameter. **Conclusions:** Combining activity with immobilization did not result in additional morphological benefits compared to continuous immobilization. However, reduced orthosis-wearing time achieved similar effects and may improve treatment compliance in children with CP.

PMID: [41897127](#)

12.Mixed-Method Follow-Up of Toddler-Aged Children with Spastic Cerebral Palsy After an Intense Physical/Occupational Therapy Intervention

Heidi L Pottinger, Nicole P Yuan, Burris Duncan

Children (Basel). 2026 Feb 25;13(3):321.

Background/Objectives: Although many studies report the effectiveness of interventions for managing cerebral palsy (CP), few examine long-term outcomes after intensive therapy. This observational mixed-methods study examined functional gains more than one year after toddlers completed a 48-week investigation that included 12 weeks of intensive occupational and physical therapy using the Perception–Action Approach. The aim was to determine whether functional gains continued to improve, plateaued, or declined at long-term follow-up. **Methods:** Twenty-three children with mild-to-moderate CP who completed the original study at least one year earlier were included. Quantitative follow-up assessments used the Gross Motor Function Measure-66 and the Pediatric Evaluation of Disability Inventory–Functional Skills. Qualitative data were collected from caregivers using open-ended questionnaires to capture perceptions of child functioning and intervention impact. **Results:** Quantitative findings showed that a subset of children exceeded expected developmental trajectories, others met expectations, and some did not. Children with GMFCS II or III maintained functional positioning on disability measures. Qualitative findings indicated that caregivers perceived improvements in physical, cognitive, and social functioning, and many reported that participation helped overcome barriers to accessing intensive therapy. **Conclusions:** At long-term follow-up, approximately one-third of children exceeded predicted motor outcomes, while another third did not meet expectations. Despite the intensity of the intervention, caregivers largely perceived it as a key contributor to improvements in their children’s functioning.
PMID: [41897033](#)

13.Biomechanical and Functional Outcomes of High-Burden and Low-Burden Multilevel Surgery in Young People with Cerebral Palsy

Victoria Hinchberger, Brittany A Virgil, Chris Church, Jose J Salazar-Torres, Jason J Howard, Anjana N Bhat, John D Henley, M Wade Shrader, Freeman Miller, Nancy Lennon

Dev Med Child Neurol. 2026 Mar 27. Online ahead of print.

Aim: To compare changes in gait biomechanics and mobility function in ambulatory young people with cerebral palsy undergoing low- or high-burden multilevel orthopedic surgery. **Method:** This retrospective cohort study analyzed preoperative and postoperative gait and functional outcomes in young people with cerebral palsy classified as GMFCS I–III. Outcomes included gait deviation index, gross motor function, gait velocity, patient-reported outcomes, and walking activity. Statistical analyses evaluated the impact of surgical burden and baseline characteristics on postoperative change. **Results:** Both low- and high-burden surgery groups demonstrated improvements in gait deviation index. Greater functional improvements in gross motor function, gait velocity, and patient-reported outcomes were observed in the low-burden group. Baseline functional status and GMFCS level were significant predictors of postoperative change. **Interpretation:** While gait pattern improved following both surgical approaches, low-burden multilevel surgery was associated with greater functional gains. These findings may assist clinicians in surgical decision-making and postoperative planning.
PMID: [41895822](#)

14. CIMT Combined with BoNT-A Regenerates Skeletal Muscle and Improves Upper Limb Function through Activating IGF-1/FGFR2 Axis in Hemiplegic Cerebral Palsy

You Wang, Qihong Wu, Xiuying Zhao, Jie Luo, Yaodan Liang, Kaiyin Cai, Linlin Wu, Xiaolin Guo, Mengru Zhong, Yage Zhang, Xubo Yang, Tingting Peng, Shanshan Liu, Jinling Li, Liru Liu, Lu He, Xiaoping Liu, Kaishou Xu, Hongmei Tang

Exp Neurol. 2026 Mar 25. Online ahead of print.

Background: Hemiplegic cerebral palsy (HCP) is a prevalent cause of pediatric motor disability. Constraint-induced movement therapy (CIMT) combined with botulinum neurotoxin type A improves upper limb function and social participation in individuals with HCP, but the underlying mechanisms remain unclear. Methods: Sixty children with cerebral palsy were recruited to receive CIMT or CIMT combined with botulinum neurotoxin type A, and treatment effects were assessed using the Melbourne Assessment 2 and Modified Ashworth Scale. An additional cohort of forty-six children was enrolled for serum proteomic analysis. Hemiplegic CP rats were treated with CIMT alone, CIMT combined with botulinum neurotoxin type A, or combined treatment plus an IGF-1 receptor inhibitor. IGF-1 levels, muscle morphology, muscle satellite cell activation markers, RNA sequencing, and downstream targets were assessed. Results: Combined treatment led to greater functional improvements and significantly increased serum IGF-1 levels in children. In rats, combined treatment improved forelimb function, increased IGF-1 levels, promoted ordered muscle fiber arrangement, and increased expression of PAX7, MyoD, and MyoG. Inhibition of IGF-1 signaling reversed these effects. RNA sequencing identified FGFR2 as a downstream target of IGF-1, which was upregulated by combined treatment. Conclusion: CIMT combined with botulinum neurotoxin type A enhances skeletal muscle regeneration and functional recovery in hemiplegic cerebral palsy through activation of the IGF-1/FGFR2 pathway.

PMID: [41895393](#)

15. Innovative Management of Spastic Shoulder Contractures: A Retrospective Cohort Analysis of Combined Percutaneous Cryoneurolysis and Tenotomy

Paul Winston, Mahdis Hashemi, Fraser MacRae, Samuel Herzog, Maxime Billot, Romain David

Toxins (Basel). 2026 Mar 11;18(3):137.

Abstract

Shoulder spasticity following upper motor neuron lesions is frequently associated with soft tissue contractures and reduced range of motion. This retrospective single-centre cohort study evaluated the combined effect of percutaneous cryoneurolysis and pectoral tenotomy in patients with refractory shoulder spasticity and contracture. Fifteen adults with chronic shoulder spasticity and musculotendinous contracture, previously treated with botulinum toxin without sufficient response, underwent cryoneurolysis of motor branches to the pectoral muscles followed by percutaneous tenotomy. Outcomes included Modified Ashworth Scale and shoulder passive range of motion. Significant reductions in spasticity and significant improvements in shoulder flexion and abduction range of motion were observed. The combined intervention was feasible, safe, and clinically beneficial, addressing both neural and mechanical components of spastic shoulder contracture.

PMID: [41893560](#)

16. Transcranial Photobiomodulation for Spasticity in Pediatric Cerebral Palsy: A Scoping Review of Neurodevelopmental Considerations, Treatment Protocols, Functional Outcomes, and Methodological Gaps

Amalio Jiménez, Frederick R Carrick, Monèm Jemni

Brain Sci. 2026 Feb 28;16(3):272.

Background: Spasticity affects more than 80% of children with cerebral palsy and is a major contributor to disability. Transcranial photobiomodulation has emerged as a potential non-invasive neuromodulatory therapy, but evidence in paediatric cerebral palsy remains limited. Methods: This scoping review followed PRISMA-ScR guidelines and included studies from January 2000 to September 2025 involving children and adolescents with cerebral palsy and spasticity who received photobiomodulation with a transcranial focus. Results: Only five primary studies involving a total of 45 children met inclusion criteria. The evidence base was extremely limited and heterogeneous, with substantial variability and inconsistency in treatment protocols and dosimetry reporting. No adequately blinded or sham-controlled trials were identified. Although reductions in spasticity and improvements in motor outcomes were reported, the risk of bias was high. Conclusions: Current evidence supporting transcranial photobiomodulation for spasticity in paediatric cerebral palsy is pre-preliminary. Substantial methodological limitations and lack of standardisation preclude clinical recommendations, highlighting the urgent need for rigorous, sham-controlled trials with paediatric-specific safety protocols.

PMID: [41892615](#)

17. Agilik@home: A Randomized Controlled Trial Protocol to Evaluate the Effects of Home-Based Training with the Agilik Powered KAFO in Children with Cerebral Palsy and Crouch Gait

Roberta Nossa, Fabio Alexander Storm, Eleonora Diella, Riccardo Riboni, Luca Emanuele Molteni, Mattia Chiappini, Cristina Maghini, Elena Beretta, Roberta Nicotra, Sara Abbondio, Carolina Ferrante, Annalisa Cotardo, Giada Sgherri, Marco Germanotta, Maria Cristina Mauro, Alessio Fasano, Carlotta Cordoni, Maurizio Ferrarin, Anna Cavallini, Sabrina Giovanna Signorini, Giuseppina Sgandurra, Irene Aprile, Laura Iuvone, Angela Cavalagli, Emilia Biffi

PLoS One. 2026 Mar 25;21(3):e0340877.

Background: Cerebral palsy is the most common neuromotor disability in children and may result in crouch gait, characterized by excessive knee flexion and impaired walking. The Agilik powered knee–ankle–foot orthosis is designed to enhance knee extension and improve gait. This article outlines a randomized controlled trial protocol evaluating Agilik in a home-based setting. **Methods:** The multicenter trial will enrol 40 children with cerebral palsy and crouch gait, assigning participants to either Agilik training or usual care. Outcomes will be assessed at baseline, post-intervention, and one-month follow-up. **Primary outcomes** include the 6-minute walk test and knee extension during gait. **Secondary outcomes** encompass gait parameters, gross motor function, spasticity, balance, and patient-reported engagement and usability. **Discussion:** This trial will provide evidence on the feasibility and effectiveness of a powered orthosis for managing crouch gait in children with cerebral palsy, with potential implications for clinical practice and quality of life.

PMID: [41880375](#)

18. Efficacy and Safety of Baclofen 40 mg/20 mL in an Intrathecal Infusion System

Riccardo Marvulli, Serena Gervasi, Giuseppa Lagioia, Lucrezia Dell'Olio, Serena Caforio Montesardo, Marisa Megna, Maurizio Ranieri

Life (Basel). 2026 Mar 14;16(3):473.

Background: Spasticity is a common feature of Upper Motoneuron Syndrome and is frequently treated with intrathecal baclofen (ITB) when oral therapy is ineffective or poorly tolerated. Different baclofen formulations are available for intrathecal use, but evidence regarding their clinical equivalence in patients requiring high daily doses remains limited. **Methods:** Thirty adult patients (mean age 37 ± 5.8 years) receiving long-term ITB therapy were switched from four vials of baclofen 10 mg/5 mL to a single vial of baclofen 40 mg/20 mL, while maintaining the same total drug amount and reservoir concentration. Patients were divided into two groups: in 15 patients, the daily baclofen dose was maintained unchanged, while in the remaining 15 patients a 10% dose reduction was attempted. **Clinical outcomes** were assessed at baseline and during follow-up using validated scales for spasticity, pain, and functional status. **Results:** In patients with unchanged daily dosing, no clinically relevant differences were observed in spasticity, pain, or functional independence after switching formulation, supporting clinical equivalence between the two preparations. Conversely, the 10% dose reduction proved clinically unsustainable in patients requiring high daily doses and required restoration of baseline dosing in all cases. No adverse events or formulation-related complications were observed. **Conclusions:** Switching to baclofen 40 mg/20 mL is safe and clinically equivalent to the conventional 10 mg/5 mL formulation when the daily dose is maintained unchanged. Dose reduction appears unsuitable in patients requiring high daily intrathecal baclofen doses.

PMID: [41900991](#)

19. Standard Work Tools for Managing Pediatric Baclofen Pump Infections and Withdrawal

Rishi Jain, Benjamin E Weiss, Elizabeth Snider, James M Mossner, Jeffrey S Raskin

Childs Nerv Syst. 2026 Mar 21;42(1):125.

Objective: Intrathecal baclofen pumps are effective for managing spasticity and dystonia in children but carry risks of infection and withdrawal. This study aimed to develop and implement standardized work tools to guide evaluation and management of baclofen pump infection and withdrawal in pediatric patients. **Methods:** Pediatric neurosurgery and physical medicine and rehabilitation physicians collaboratively developed two structured tools addressing diagnosis and management of pump infection and structured weaning protocols for withdrawal prevention. These tools were implemented and evaluated in clinical cases requiring pump interrogation or removal. **Results:** The standard work tools enabled consistent multidisciplinary management, standardizing pump assessment, laboratory evaluation, drug conversion strategies, dose-based weaning thresholds, and escalation pathways for severe cases. Effectiveness was demonstrated through representative infection and withdrawal cases. **Conclusions:** Standard work tools improve safety, consistency, and timeliness in the management of pediatric intrathecal baclofen pump complications. Broader adoption may reduce treatment variability and support improved long-term outcomes.

PMID: [41863662](#)

20. Validity, Reliability and Interpretability of an IMU-Based System to Measure 3D Lower Limb Kinematics of Patients with Heterogeneous Gait Disorders

Lena Carcreff, Gabriel Payen, Gautier Grouvel, Mickael Cardoso-Fonseca, Fabien Massé, Stéphane Armand

Sensors (Basel). 2026 Mar 10;26(6):1746.

Abstract

Inertial measurement units (IMUs) represent a promising alternative to optoelectronic systems for estimating gait kinematics in less resource-intensive laboratories. However, evidence regarding the clinical interpretability of IMU-based gait analysis in pathological populations remains limited. This study aimed to evaluate the concurrent validity, reliability, and interpretability of an IMU-based method for computing 3D lower limb kinematics in asymptomatic and pathological populations. Fifty-five participants, including asymptomatic individuals (AS, n = 15), patients with cerebral palsy (CP, n = 15), and individuals with various motor disorders (OMD, n = 25), were assessed using a 7-IMU system and an optoelectronic system. Validity was quantified using root mean square error (RMSE), centered RMSE, and Pearson correlation coefficients (CCs) across 11 commonly reported lower limb kinematic outcomes. Reliability was assessed using intraclass correlation coefficients (ICCs), and interpretability was examined by comparing Gait Profile Scores (GPS) derived from both systems. Mean RMSE values were 7.1° (AS), 9.8° (CP), and 9.3° (OMD), with centered RMSE values below 3.2°. The correlation between IMU- and optoelectronic-based kinematics was good to excellent (mean CC = 0.76). Reliability ranged from moderate to excellent, and GPS showed moderate agreement between systems (CC = 0.42). These findings support the clinical validity, reliability, and interpretability of IMU-based gait kinematics across heterogeneous gait disorders.

PMID: [41901917](#)

21. Automated Analysis of Pelvic Radiographs for Hip Dysplasia Screening Using Artificial Intelligence in Children with Cerebral Palsy: A Systematic Review

Ayesha Barmare, Erich Rutz, Sharmala Thuraisingam, Daniel Gould

Medicina (Kaunas). 2026 Mar 18;62(3):570.

Background and Objectives: Cerebral palsy is a debilitating and complex movement disorder affecting millions of people worldwide. Many children with cerebral palsy develop hip dysplasia, which can lead to pain, functional decline, and long-term complications. Regular hip surveillance is therefore essential to allow early intervention and prevent progression. At present, screening is performed manually by experienced clinicians, which can be time consuming and costly. This study aimed to compare the performance of artificial intelligence models with expert clinicians in detecting hip dysplasia in children with cerebral palsy. **Materials and Methods:** A thorough search of Embase, Ovid MEDLINE, and Web of Science was conducted from inception to July 2025. Studies evaluating AI-based detection of hip dysplasia in children aged 18 years or younger with cerebral palsy were included. Risk of bias was assessed using the QUADAS-2 tool. Results were synthesised narratively in accordance with SWiM guidelines. **Results:** Across the six included studies, which included over 4000 radiographs, AI sensitivity for detecting hip dysplasia ranged from 70% to 97.4%, and specificity ranged from 85% to 96%, depending on the migration percentage thresholds applied. Area under the curve values ranged from 0.923 to 0.999. Only one study performed external validation using a national surveillance dataset. Risk of bias was moderate to high in most studies due to internal validation and small datasets. **Conclusions:** The findings suggest that AI demonstrates potential as an adjunct for hip surveillance in children with cerebral palsy.

PMID: [41901651](https://pubmed.ncbi.nlm.nih.gov/41901651/)

22. Measuring Assistive Technology Outcomes via AI-Based Kinematic Modeling of Individualized Routine Learning in Elite Boccia Athletes with Severe Cerebral Palsy: A Longitudinal Case Series

Se-Won Park, Young-Kyun Ha

Bioengineering (Basel). 2026 Feb 25;13(3):261.

Objectives: This longitudinal single-case series evaluated an AI-based routine-learning system as assistive technology (AT) for elite Boccia athletes with severe Cerebral Palsy (CP). The study aimed to provide an innovative outcome measurement approach for individualized monitoring by integrating performance scores and longitudinal kinematic variability indicators. **Methods:** Three national-level players performed 694 throws over eight weeks. To ensure technical credibility, trials were rated through a consensus-based assessment by a panel of two experts, serving as ground truth for AI modeling. The system utilized a Bidirectional Long Short-Term Memory (Bi-LSTM) architecture to extract 29 kinematic features and perform regression-based scoring, providing real-time augmented feedback. **Results:** High-baseline tasks maintained stable scores (7–9), while intermediate tasks showed significant score increases, reflecting motor learning transitions. The model achieved a Mean Squared Error of 1.14 and a Mean Absolute Error of 1.13, demonstrating high alignment with expert standards. Training demonstrated stable convergence, with loss reducing from 7.45 to 1.19. Notably, for the most severely impaired athlete, the AI system detected a 4.69% reduction in kinematic variability despite stagnant performance scores. This provides empirical evidence of movement stabilization within the cognitive stage that traditional observation might overlook. **Conclusions:** The Bi-LSTM system enabled accurate tracking of performance and motor variability, revealing distinct learning curves based on task difficulty. These findings demonstrate the feasibility of AI-enabled motion analysis as an AT for outcome measurement, supporting data-driven coaching where conventional evaluation is constrained by the rarity and severity of disabilities.

PMID: [41899793](https://pubmed.ncbi.nlm.nih.gov/41899793/)

23. Eye Tracking for Rehabilitation and Training in Paediatric Neurodevelopmental Disorders: A Systematic Review

Guido Catalano, Sara Abbondio, Roberta Nicotra, Valentina Berselli, Marta Guarischi, Valentina Vezzali, Sabrina Signorini

Brain Sci. 2026 Mar;16(3):337.

Background: Eye-tracking devices are gaining attention in technology-based paediatric rehabilitation due to their ability to assess engagement and visual attention in motivating digital environments. This systematic review examined evidence from 2004 to 2025 on the use of eye tracking in rehabilitative training for paediatric populations with neurological and neurodevelopmental disorders. **Methods:** The review followed PRISMA guidelines and searched PubMed, Web of Science, and Scopus to summarise the state of the art over the last 20 years. Studies were categorised by type of disorder and rehabilitated function. **Results:** Eye-tracking systems have been increasingly integrated into paediatric rehabilitation with promising outcomes across multiple neurodevelopmental conditions, including autism spectrum disorder, attention-deficit/hyperactivity disorder, and cerebral palsy. These systems were effective not only for training gaze control but also for improving executive functions, social cognition, communication, and participation. They also supported personalised, data-driven approaches and high levels of engagement and feasibility. **Conclusions:** Eye tracking represents a promising approach for paediatric rehabilitation across neurodevelopmental disorders. Gaze-contingent protocols show potential for promoting adaptive behaviour in multiple developmental domains, although further research is needed to strengthen practice recommendations.

PMID: [41892679](#)

24. Validation and Reliability of Kinovea Video Analysis for Temporomandibular and Cervical Range of Motion in Children with Spastic Cerebral Palsy

Özge Baykan Çopuroğlu, Baki Umut Tuğay, Muhammet Furkan Vatan

Front Bioeng Biotechnol. 2026 Mar 11;14:1731269.

Introduction: Spastic cerebral palsy affects mandibular and cervical motor control, highlighting the importance of accurate range-of-motion assessment. This study evaluated the validity and reliability of Kinovea video analysis as a two-dimensional digital alternative to manual goniometry. **Methods:** Fifty-two children with spastic cerebral palsy underwent temporomandibular and cervical range-of-motion assessment using manual goniometry and Kinovea analysis. Measurements were conducted by two raters across two sessions. Concurrent validity, intra- and inter-rater reliability, standard error of measurement, minimal detectable change, and agreement analyses were performed. **Results:** Kinovea demonstrated excellent concurrent validity with manual goniometry and high intra- and inter-rater reliability across all movements. Measurement error values were low, indicating high precision, and agreement analysis showed minimal bias between methods. **Discussion:** Kinovea provides a precise, reproducible, and clinically feasible method for assessing temporomandibular and cervical range of motion in children with spastic cerebral palsy, supporting its use in routine clinical and tele-assessment settings.

PMID: [41890355](#)

25. Artificial Intelligence in Prechtl's General Movements Assessment: A Systematic Review and Meta-Analysis

Zhanna Zhussupova, Amin Tamadon, Natalya Chagay, Nadiar M Mussin, Ramazon Safarzoda Sharoffidin

J Neonatal Perinatal Med. 2026 Mar 25. Online ahead of print.

Objective: To evaluate AI-assisted General Movements Assessment (GMA) performance for prediction of later cerebral palsy diagnosis and classification of expert-rated GMA labels, and to assess heterogeneity and risk of bias. **Methods:** A systematic review and meta-analysis was conducted according to PRISMA 2020 guidelines. One hundred and five studies were included in qualitative synthesis, of which 28 were eligible for quantitative synthesis. Random-effects meta-analysis of proportions with logit transformation was used to estimate pooled diagnostic accuracy. **Results:** Twenty-eight studies were included in quantitative synthesis. For cerebral palsy diagnosis outcomes, pooled diagnostic accuracy was 0.884. For expert-rated GMA label outcomes, pooled classification accuracy was 0.848. Substantial heterogeneity was observed. **Interpretation:** AI-assisted GMA demonstrates high pooled performance for cerebral palsy prediction and expert-label classification; however, certainty remains very low due to heterogeneity and risk of bias. These findings support the clinical potential of AI-enabled GMA as an objective and scalable screening tool, emphasizing the need for standardized protocols and high-quality validation.

PMID: [41880997](#)

26. Long-Term Neurodevelopmental Outcomes and Prognostic Factors in Neonates with Hypoxic-Ischemic Encephalopathy

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J Clin Med. 2026 Mar 21;15(6):2414.

Background: Hypoxic-ischemic encephalopathy (HIE) remains a major cause of neonatal mortality and long-term neurodevelopmental impairment despite advances in perinatal care and the widespread use of therapeutic hypothermia. Reliable early prognostic markers are essential for risk stratification and long-term follow-up planning. This study aimed to evaluate long-term neurodevelopmental outcomes and associated prognostic factors in neonates with HIE treated in the era of therapeutic hypothermia. **Methods:** This retrospective cohort study was conducted in a tertiary neonatal intensive care unit between January 2020 and June 2024. Neonates with gestational age ≥ 35 weeks diagnosed with HIE were included. Clinical characteristics, laboratory parameters, neurophysiological findings, neuroimaging results, and indicators of multiorgan dysfunction were recorded. Long-term neurodevelopmental outcomes were assessed at 18 to 24 months of age. The primary outcome was death or severe neurodevelopmental impairment. Multivariable logistic regression analysis was performed to identify independent predictors of adverse outcomes. **Results:** A total of 99 neonates were included. Therapeutic hypothermia was administered to 86 (86.9%) infants. Severe neurodevelopmental impairment or death occurred in 18 (18.2%) patients. Cerebral palsy was diagnosed in 19 (20.9%) survivors, developmental delay in 12 (13.2%), epilepsy in 16 (17.6%), and feeding difficulties in 9 (9.9%). In multivariable analysis, higher lactate levels (adjusted OR = 1.239, 95% CI = 1.052–1.458), lower Apgar score at 5 min (adjusted OR = 0.570, 95% CI = 0.344–0.944), and renal dysfunction (adjusted OR = 7.947, 95% CI = 2.027–31.164) were independently associated with severe neurodevelopmental impairment or death. Multiorgan dysfunction and abnormal neurophysiological and neuroimaging findings were significantly associated with adverse outcomes. **Conclusions:** Early biochemical markers, neurological assessments, neurophysiological recordings, neuroimaging patterns, and systemic organ dysfunction are closely associated with long-term neurodevelopmental outcomes in neonates with HIE. A multidimensional approach to early prognostic evaluation may improve risk stratification and guide targeted follow-up and intervention strategies.

PMID: [41899339](#)

27. The Interrater Reliability of the Greek Expanded and Revised Gross Motor Function Classification System and the Family Report Questionnaire in Cerebral Palsy

Vasileios C Skoutelis, Renata Moutsiou, Maria Spanou, Zacharias Dimitriadis, Efstratia Kalamvoki, Vasiliki Zouvelou, Argyrios Dinopoulos

Children (Basel). 2026 Mar 5;13(3):368.

Background/Objectives: The Gross Motor Function Classification System–Expanded and Revised (GMFCS-E&R) is widely used to describe gross motor performance in children with cerebral palsy (CP). Although Greek-language versions are available, interrater reliability among healthcare professionals and parents has not been established. This study evaluated the interrater reliability of the Greek GMFCS-E&R and the Family Report Questionnaire. **Methods:** A cross-sectional study was conducted in 111 children and adolescents with CP aged 2–18 years. A pediatric neurologist and pediatric physiotherapist independently classified motor function using the GMFCS-E&R, while parents completed the Family Report Questionnaire. Agreement among raters was assessed using Fleiss' kappa and weighted Cohen's kappa statistics. **Results:** Overall interrater reliability was substantial. Agreement increased with age, with the highest reliability observed in adolescents. Pairwise agreement was excellent across all rater combinations, particularly between healthcare professionals. In most disagreements, parents assigned higher GMFCS levels, typically within adjacent categories. **Conclusions:** The Greek GMFCS-E&R demonstrates high interrater reliability among professionals and parents. The Family Report Questionnaire effectively captures parental perspectives and complements clinical assessments, supporting its use in clinical practice and research.

PMID: [41897081](#)

28. Sleep-Disordered Breathing in Children with Cerebral Palsy Compared to Non-Neurological Controls: A Prospective Study from a Tertiary Center in Jordan

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Neurol Int. 2026 Mar 2;18(3):49.

Background/objectives: The study aimed to evaluate sleep quality and the prevalence of obstructive sleep apnea in children with cerebral palsy and other neurological disorders using polysomnography and validated sleep questionnaires. **Methods:** Children recruited from pediatric neurology clinics underwent polysomnography, while caregivers completed the Pediatric Sleep Questionnaire and Sleep Disturbance Scale for Children. **Results:** Among 296 participants, children with cerebral palsy showed significantly lower sleep efficiency compared to non-neurological controls. Total sleep time was reduced compared to controls but longer than in children with Down syndrome. Apnea–hypopnea and arousal indices were comparable to controls and lower than in syndromic groups. Questionnaire data indicated higher overall sleep disturbance risk in neurological patients, though obstructive sleep apnea risk was not significantly increased. **Conclusion:** Children with neurological disorders are at increased risk of sleep disturbances, though this is less pronounced in cerebral palsy. Polysomnography remains the most reliable method for assessment.

PMID: [41893051](#)

29. The Quality of Life of Parents of Children with Disabilities in Saudi Arabia: A Systematic Review

Abdullah Ahmed Alghamdi, Mohammad S Alzahrani, Atiah H Almalki, Majed A Algarni

Front Pediatr. 2026 Mar 6;14:1660247.

Introduction: This systematic review examined the quality of life (QoL) of parents and caregivers of children with disabilities in Saudi Arabia. **Methods:** Fourteen cross-sectional studies published between 2020 and 2024 were included, comprising 1,841 caregivers of 1,460 children with disabilities. QoL was primarily measured using the WHOQOL-BREF, with additional use of the SF-36 and the Beach Center Family Quality of Life Scale. **Results:** Autism spectrum disorder, attention-deficit/hyperactivity disorder, cerebral palsy, and Down syndrome were the most common conditions. Negative QoL outcomes were reported in at least one domain in most studies, with the physical domain most frequently affected, followed by social, environmental, and psychological domains. Poorer QoL was consistently associated with unemployment, lower income, limited education, and restricted access to support services. **Conclusion:** Reduced QoL was most frequently observed among mothers and caregivers of children with severe or multiple disabilities, emphasizing the need for targeted support strategies.

PMID: [41867922](#)

30. Disability Community Perspectives on Participation in Research and Studying Positive Health

Melissa M Murphy, Judy L Aschner, Paige S Ryals, Ana Joselyn Barahona, Jennifer Lyman, Ashley Harris Whaley, Rachel Byrne, Nathalie L Maitre

Children (Basel). 2026 Mar 20;13(3):430.

Background/Objectives: Disability affects approximately 15.7 million children and 67 million adults in the United States, yet these individuals are often under-represented in clinical research. Research has increasingly expanded its focus to include positive health, defined as the capacity to adapt to challenges rather than simply the absence of disease. **Methods:** A mixed-methods approach was used to investigate disability community perspectives on research participation and the use of positive health as an outcome in childhood-onset disability. **Results:** Nationally, approximately one-quarter of adults with disabilities and parents or caregivers reported participation in non-disability-specific research. Around 23% of adults and 30% of parents or caregivers reported being excluded from research because of disability, despite more than 80% endorsing health outcomes research. Disability stakeholders unanimously expressed the need to reframe positive health in a disability context, develop guidance for its use as a research outcome, and provide a roadmap to improve research inclusion. **Conclusions:** Reframing positive health may enhance its relevance for people with disabilities. A pragmatic action plan is proposed to improve the relevance, generalizability, and impact of clinical research.

PMID: [41897142](#)

31. Motor Skills and Outcomes of Activities and Participation in Children and Adults Born Preterm without Cerebral Palsy: A Systematic Review

Kari Anne I Evensen, Silje Dahl Benum, Henriette Paulsen, Kristina Anna Djupvik Aakvik, Sindre Andre Pedersen, Tordis Ustad

Dev Med Child Neurol. 2026 Mar 27. Online ahead of print.

Aim: To determine whether motor skills in children and adults born preterm without cerebral palsy are associated with outcomes of activities and participation within the International Classification of Functioning, Disability and Health. **Method:** A systematic search of MEDLINE, Embase, and Web of Science identified observational studies reporting associations between motor skills and activities and participation outcomes in individuals born preterm without cerebral palsy. Screening, data extraction, and quality assessment were conducted independently by two reviewers. **Results:** Thirty-six studies published between 1988 and 2025 examined 56 associations between motor skills and activities and participation outcomes. Most associations involved learning, applying knowledge, and general tasks and demands. Half of the reported associations were positive, while others were inconsistent or showed no association. **Interpretation:** Available evidence indicates that motor skills are associated with activities and participation outcomes in children and adults born preterm without cerebral palsy. Awareness of these associations may inform assessment and intervention strategies.

PMID: [41895852](#)

32. Assessing Motivation in Cerebral Palsy During Rehabilitation: A Systematic Review

Daniela De Bartolo, Marco Iosa, Sara Simigliani, Fulvia Di Iulio, Irene Ciancarelli, Giovanni Morone

Brain Sci. 2026 Mar 5;16(3):291.

Background: Motivation plays a key role in learning and rehabilitation outcomes in children with cerebral palsy, yet it is rarely assessed systematically in paediatric neurorehabilitation. This review examined how motivation-related constructs are measured in rehabilitation studies involving children with cerebral palsy. **Methods:** A systematic mapping review following PRISMA guidelines searched PubMed and Scopus for studies published between 2013 and 2025 that included rehabilitation interventions with explicit motivation-related outcomes. **Results:** Nine studies involving 109 participants were included. Most involved children with mild to moderate motor impairments. Motivation was assessed using heterogeneous constructs such as self-efficacy, mastery motivation, participation, adherence, and intrinsic motivation, with reports from children, parents, therapists, or combined perspectives. **Conclusions:** Motivation is frequently cited as a critical factor in cerebral palsy rehabilitation, but its assessment remains inconsistent and fragmented. There is a clear need for standardized, validated, and developmentally appropriate tools to measure motivation-related constructs in paediatric cerebral palsy rehabilitation.

PMID: [41892634](#)

33. Family Perspectives on Independent Living for Adults with Cerebral Palsy: Barriers, Support Needs, and Quality of Life

Virginia Aguayo, Laura Esteban, Laura García-Domínguez, Miguel A Verdugo

Front Psychiatry. 2026 Mar 11;17:1785081.

Introduction: Independent living is recognized as a fundamental right, yet many adults with cerebral palsy remain dependent on family caregivers or institutional arrangements, affecting autonomy and quality of life. This study explored family caregivers' understandings of independent living, perceived barriers, and support needs for promoting quality of life in adults with cerebral palsy. **Methods:** An interpretive qualitative study was conducted with 165 family caregivers of adults with cerebral palsy across four regions in Spain. Semi-structured interviews explored meanings of independent living, feasibility, support needs, caregiving experiences, and well-being. Data were analyzed using inductive thematic analysis within a reflexive framework. **Results:** Four themes emerged: heterogeneous understandings of independence; supports as essential enabling conditions amidst persistent systemic barriers; family caregiving as a moral obligation with substantial personal and emotional costs; and well-being as a priority characterized by tensions between protection and autonomy. **Discussion:** Independent living for adults with cerebral palsy is constrained primarily by structural and organizational factors rather than individual attitudes. Families play a central role in sustaining autonomy, often at significant personal cost, underscoring the need for rights-based, personalized, and adequately resourced support systems.

PMID: [41890419](#)

34. Service Providers' Adaptations to Facilitate Family-Centered Care for Children with Cerebral Palsy: A Qualitative Study

Silje Karin Selfors Sjøseth, Veslemøy Guise, Karina Aase, Maren Kristine Raknes Sogstad

BMC Prim Care. 2026 Mar 24;27(1):99.

Background: Family-centered care is a core principle in services for children with cerebral palsy, yet sustained delivery requires ongoing adaptation by service providers. This study explored how practitioners adapt their practices to support family-centered care. **Methods:** Data were collected through focus groups with service providers and observations of multidisciplinary coordination meetings. **Results:** Service providers continually adapted practices to address diverse and evolving family needs, acknowledging variability in clinical outcomes, comorbidities, and contextual family circumstances. Adaptations supported relationship-building, early intervention, individualized care, shared decision-making, and coordination across services. **Conclusion:** Flexible and adaptive practices enabled providers to deliver family-centered care despite systemic constraints. These adaptations supported integrated service delivery aligned with families' changing needs.

PMID: [41872778](#)

Prevention and Cure

35. Neurodevelopmental Disorders in Children: The Role of MRI in Early Detection and Intervention Planning

Chen Hua, Xue-Ling Wang, Hui Sheng

Front Neurosci. 2026 Mar 11;20:1758568.

Abstract

Neurodevelopmental disorders are characterized by persistent impairments in cognition, behavior, social interaction, or motor function arising from disrupted early brain development. Early detection is critical to improve long-term outcomes, yet conventional assessments often fail to identify subtle early changes. Magnetic resonance imaging provides a powerful tool to detect neurochemical, microstructural, and functional brain abnormalities associated with conditions such as autism spectrum disorder, attention-deficit/hyperactivity disorder, cerebral palsy, genetic and metabolic syndromes, and developmental delay. Advanced modalities including diffusion imaging, quantitative MRI, resting-state functional MRI, spectroscopy, and machine learning approaches offer promising biomarkers for early detection and risk stratification. This review summarizes current pediatric MRI methodologies, disease-specific findings, and translational applications supporting early diagnosis and intervention planning.

PMID: [41890593](#)

36. Factors Associated with Appropriate Administration of Magnesium Sulfate for Neuroprotection Prior to Early Preterm Birth

Natav Hendin, Moti Gulersen, Matthew J Blitz, Burton Rochelson, Frank A Chervenak, Eran Bornstein

Am J Obstet Gynecol MFM. 2026 Mar 23. Online ahead of print.

Background: Magnesium sulfate administration prior to early preterm birth reduces the risk of cerebral palsy among surviving neonates, but adherence to neuroprotection protocols varies. Objective: To evaluate factors associated with appropriate administration of magnesium sulfate for neuroprotection before delivery prior to 32 weeks' gestation. Methods: A multicenter retrospective cohort study included preterm deliveries between 23 and 31 weeks' gestation within a large U.S. health system. Sociodemographic and obstetric characteristics were analyzed, and multivariable logistic regression identified predictors of magnesium sulfate administration. Results: Among 527 patients, 83.1% received magnesium sulfate prior to delivery. Non-administration was more common in patients admitted for non-reassuring fetal status or non-obstetric complaints and in those with shorter admission-to-delivery intervals. In multivariable analysis, time from admission to delivery was the strongest predictor of magnesium administration. Conclusions: Adherence to magnesium sulfate neuroprotection protocols was high overall. Missed administration was primarily associated with urgent clinical scenarios and limited time before delivery, highlighting the importance of system-level strategies to optimize timely neuroprotection.

PMID: [41881424](#)

37. Glucose Abnormalities in Infants with Birth Asphyxia Are Associated with Later Neurological Diagnoses

Niina Viitaharju, Vilhelmiina Parikka, Eliisa Löyttyniemi, Bishwesvar Singh, Kjell Helenius

Early Hum Dev. 2026 Mar 17;218:106536.

Objective: To investigate the association between early glycemic profile and neurological outcome in neonates with birth asphyxia. Study design: A retrospective single-center study included infants born at or beyond 36 weeks' gestation with birth asphyxia or hypoxic-ischemic encephalopathy. Early glucose values and follow-up neurological diagnoses were analyzed. Results: Among 272 infants, both hypoglycemia and hyperglycemia during the first 72 hours of life were associated with increased odds of later neurological disorders, including cerebral palsy, epilepsy, and hearing impairment. Associations were strongest in infants who did not receive therapeutic hypothermia. Conclusions: Early glucose abnormalities in neonates with birth asphyxia are associated with later neurodevelopmental disorders. These findings highlight the potential importance of glycemic monitoring and control during the early postnatal period.

PMID: [41875791](#)

38. Ambient Air Pollution during Pregnancy and Offspring Cerebral Palsy

Haoran Zhuo, Beate Ritz, Jason G Su, Roch A Nianogo, Joshua Warren, Zeyan Liew

Environ Int. 2026 Mar 18;210:110201.

Background: Cerebral palsy (CP) is a permanent neuromotor disorder of childhood onset, and the etiology of most cases remains unclear. **Methods:** A population-based case-control study was conducted in California from 2000 to 2015 including 9,343 CP cases and a 20% random sample of live births without CP. High-resolution spatiotemporal models were used to estimate prenatal exposure to particulate matter (PM_{2.5}), nitrogen dioxide, and ozone. Single-, multi-pollutant, mixture models, negative control exposure analyses, and subtype-specific analyses were performed. **Findings:** Prenatal exposure to nitrogen dioxide and ozone throughout pregnancy was associated with increased odds of CP in offspring. Stronger associations were observed when pollutants were modeled as a mixture, particularly during the first and third trimesters. Pollutant interactions were noted, and associations varied by CP subtype. Negative control exposure analyses suggested minimal unmeasured confounding. **Conclusions:** Prenatal exposure to major ambient air pollutants was associated with increased risk of cerebral palsy in offspring. Further research is needed to clarify biological mechanisms underlying these associations.

PMID: [41875667](#)