# Cerebral palsy research news

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## Interventions and Management

**1.The Traffic Light Protocol: Preventing the 90° 'Point of No Return' Through Risk-Stratified Spinal Surveillance in Children with Cerebral Palsy**

Michał Latalski, Anna Danielewicz, Martin Repko, Athanasios I Tsirikos, Tomasz Kotwicki, Tomasz Potaczek, Johanna Syvänen, Paweł Grabala, Wiktor Urbański, Martin Prýmek, Piotr Janusz, Barbara Jasiewicz, Matti Ahonen, Ilkka Helenius

J Clin Med. 2026 Apr 22;15(9):3205.

Background: Cerebral palsy (CP) is the leading cause of permanent physical disability in children. Although hip surveillance is a global standard, spinal surveillance remains inconsistent, often leading to reactive rather than proactive management of neuromuscular scoliosis. This study aims to establish an international consensus on a risk-based spinal surveillance protocol. Methods: A three-round modified Delphi process was conducted in 2024 with 15 international pediatric spine surgeons, identified through purposive sampling. The process adhered to CREDES standards and focused on establishing standards for timing, frequency, and radiographic surveillance. Consensus thresholds were defined a priori as excellent (≥80%) and good (≥73%) agreement. Results: The panel reached excellent consensus (93%) on a "Traffic Light" system based on the Gross Motor Function Classification System (GMFCS) levels. Green Group (Walkers, GMFCS I-II): Clinical surveillance. Amber Group (Poor Walkers, GMFCS III, and asymmetric hemiplegic GMFCS I-II): Annual radiographs starting at ages 3-8. Red Group (Non-Walkers, GMFCS IV-V): Six-monthly radiographs starting at ages 3-5. There was 100% consensus on the mandatory use of sitting radiographs for non-ambulatory patients to prevent masking true pelvic decompensation. Critical referral triggers were identified as a Cobb angle >20°, pelvic obliquity ≥5°, or a progression rate ≥1° per month. Conclusions: The "Traffic Light" protocol helps identify the "window of opportunity" for intervention before reaching the 90° "point of no return," where surgical risks increase nonlinearly. This proactive approach aims to reduce surgical complications and systemic delays in specialized care.
PMID: 42122938

**2.Longitudinal speech and gross motor function development in children and adolescents with cerebral palsy**

Sydney A Jensen, Katherine C Hustad

Dev Med Child Neurol. 2026 May 15. Online ahead of print.

Aim: To examine longitudinal changes in speech and gross motor function in children with cerebral palsy (CP) between 4 years and 14 years of age using the Viking Speech Scale (VSS) and the Gross Motor Function Classification System (GMFCS).
Method: In this longitudinal observational study, 44 children (26 male, 18 female) with CP were assessed at ages 4 years and 14 years. VSS and GMFCS classifications were analysed at both time points using polychoric correlations with confidence intervals generated using bootstrapping to identify patterns of stability and change.
Results: Classifications were strongly related at both ages. However, more children tended to change VSS levels (43%; 19/44) between 4 years and 14 years than GMFCS levels (34%; 15/44). Very few children demonstrated concurrent changes in both domains.
Interpretation: Changes in VSS levels may reflect protracted speech development in children with CP. Results indicate that while speech and gross motor abilities are strongly related across development, their patterns of change differ descriptively over time. These findings support the idea that children with CP may benefit from ongoing speech intervention throughout childhood and adolescence, regardless of gross motor function.
PMID: 42141517

**3.An integrated multi-variable optimization approach to tailor ankle-foot orthosis stiffness to end-user needs**

Sejin Yi-Yoo, Emma A Gille, Alejandro Dantart, Nikko Van Crey, Elliott J Rouse, Edwin H F van Asseldonk, Cristina Bayón

J Neuroeng Rehabil. 2026 May 14. Online ahead of print.

Background: Ankle foot orthosis (AFOs) are devices commonly prescribed to assist or rehabilitate gait. A critical parameter influencing their effectiveness is the stiffness of the AFO. Although suppliers typically recommend stiffness levels based on general factors, such as body weight and activity level, these guidelines are insufficient to achieve optimal stiffness tailored to each individual. In this work, we introduce an integrated multi-variable optimization approach that simultaneously considers multiple aspects of gait. Unlike previous approaches that rely on a single performance metric (e.g., metabolic cost) or impose a predefined hierarchy among gait parameters, our method does not presume any predefined prioritization among the gait features selected. Furthermore, our approach allows the inclusion of users' priorities, enabling a more personalized optimization of AFO stiffness.
Methods: Ten children with cerebral palsy (CP) participated in an experimental protocol using the inGAIT-VSO, which is a passive variable-stiffness orthosis. The participants completed five separate 2-minute walking trials, each with a different stiffness configuration of the AFO. To determine the optimal stiffness for each participant within the tested configurations, we developed an optimization method that evaluates performance across five key gait domains: kinematics, spatio-temporal, balance, user perception, and muscular control. Furthermore, we investigated the integration of physiotherapists' and users' priorities into the optimization process.
Results: The proposed optimization method identified the stiffness configuration for each child with CP that most closely aligned their gait to healthy patterns considering the five gait domains. The optimal stiffness varied not only across participants but also across gait domains within the same participant. These findings reveal the importance of having a multi-variable, user-tailored approach. Overall, the inclusion of physiotherapists' and users' priorities did not alter the optimal stiffness selection.
Conclusion: Optimizing the preferred stiffness requires consideration of multiple variables. Our proposed method opens new possibilities for future research into the personalization and fine-tuning of AFO stiffness. In the future, this approach may benefit from expanded data collection efforts that enable a more efficient evaluation, for example by exploring the potential of deep learning models, which might support its integration into clinical practice.
PMID: 42135709

**4.A Multicenter Standardized Gait Database from the ORITEL Network for Cerebral Palsy Gait Analysis**

Rosario Ulloa, Esteban J Pino, Monica Morante, Lorena Llorente, Veronica Rattin, Manuela Galli

IEEE J Biomed Health Inform. 2026 May 11. Online ahead of print.

Abstract
Gait analysis is a cornerstone of clinical decision-making in cerebral palsy (CP), yet multicenter variability limits comparability and translation. This work reports the creation of a standardized, multicenter gait database and a machine learning (ML) classifier to distinguish gait patterns of CP hemiplegia, CP diplegia, and typically developing group to validate the database. Data is contributed by eight ORITEL motion analysis laboratories (156 sessions, 582 trials) using two systems (Vicon/BTS), with unified nomenclature, unit normalization, and resampling. For classification, 95 sessions (413 trials) meeting inclusion criteria were retained. Feature sets combined kinematic, spatiotemporal, and anthropometric variables. Class imbalance was addressed using sample weighting, dimensionality was reduced with PCA (95% variance), and models were tuned with Optuna and evaluated using stratified group cross-validation and a held-out set. A multilayer perceptron (MLP) with sample weighting achieved the best performance (test accuracy 82%; class F1-scores: diplegia 0.81, hemiplegia 0.63, control 0.98). Feature importance and nonparametric statistics highlighted clinically interpretable discriminants-double support, stride length, swing/stance phases, and minimum knee flexion. An exploratory linkage between classified patterns and reported treatments suggested distinct tendencies across hemiplegia and diplegia, aligning with evidence-based recommendations. The proposed resource and pipeline advance multicenter data standardization and provide a clinically grounded baseline for data-driven support of rehabilitation planning in CP.
PMID: 42113653

**5.Does a second course of low-frequency repetitive transcranial magnetic stimulation enhance neuroplasticity and motor function in children with hemiplegic cerebral palsy? Results of a prospective study**

Fani Galabova-Petrova, Ivan Ivanov

Front Hum Neurosci. 2026 Apr 29:20:1829142. eCollection 2026.

Background: Repetitive transcranial magnetic stimulation (rTMS) has emerged as a promising neuromodulation technique for enhancing motor recovery in children with hemiplegic cerebral palsy. However, long-term effects of repeated rTMS courses remain unclear, as existing studies have focused primarily on short-term outcomes following a single treatment course, with limited data on whether benefits decline, persist, or can be restored by a second course.
Objective: To investigate the immediate and sustained neurophysiological and functional effects of two courses of low-frequency rTMS applied to the contralesional motor cortex in children with hemiplegic CP.
Methods: Fifteen children (mean age 9.5 ± 2.8 years; GMFCS I-II, MACS I-II) received two courses of 1 Hz rTMS separated by 3 months. Each course consisted of 10 daily sessions at 90% resting motor threshold, targeting the contralesional motor cortex. Assessments at six time points included neurophysiological parameters (motor threshold MT; motor evoked potentials (MEP) latency and amplitude; cortical silent period, CSP) and functional tests (Finger Tapping, FT; Box and Blocks, BB; Melbourne Assessment, MA; Timed Up and Go, TUG; 1-Minute Walk Test, Berg Balance Scale, BBS).
Results: Following the first rTMS course, MT decreased by 32% (upper limb) and 29% (lower limb); MEP latency shortened by 12 and 9%, respectively; MEP amplitude increased by 17 and 18%; and CSP decreased by 31 and 34% (all $p < 0.001$). Functional improvements consisted of 12% increase in FT and 8.5% in BB, 16% faster TUG, 16% greater 1-min walking distance, and 6.5% improved balance in BBS (all $p < 0.001$). During 3-month follow-up, effects gradually declined but remained significantly better than baseline. The second rTMS course produced similar magnitude improvements, restoring parameters to first-course post-treatment levels. No significant difference was found between neurophysiological and functional parameters 1 month after the first and 1 month after the second course, with the exception of progressive prolongation CSP.
Conclusion: Repeated courses of low-frequency rTMS were associated with reproducible within-subject improvement in neurophysiological and functional measures in children with hemiplegic cerebral palsy. These effects appeared to partially decline over 3 months, and a second course was associated with restoration of treatment benefits without generating further major cumulative gains.
PMID: 42137640

**6.TMS-biomarkers discovery in children and adolescents with neurological disorders: A systematic review and meta-analysis**

Wen Yurong, Cheng Si, Hasi Bageng, Liang Limei, Zhang Chunlan, Yuan Ruochao, Xia Lirong, Wang Qiu

Review Prog Neuropsychopharmacol Biol Psychiatry. 2026 May 13:147:111735. Online ahead of print.

Abstract
This systematic review and meta-analysis examined the application of transcranial magnetic stimulation (TMS) electrophysiological biomarkers in children and adolescents, focusing on their role in assessing neurological disorders. We synthesized data from 26 studies to compare TMS measures between healthy children/adolescents and adults, and evaluated their diagnostic discriminability in attention-deficit/hyperactivity disorder (ADHD), Tourette syndrome (TS), major depressive disorder (MDD), autism spectrum disorder (ASD), and cerebral palsy (CP). Key findings revealed that, ADHD was associated with increased SICI ratios and shortened cortical silent period (CSP); TS showed reduced CSP; MDD exhibited decreased CSP, enhanced intracortical facilitation (ICF), and weakened long-interval intracortical inhibition (LICI). Additionally, atypical interhemispheric asymmetry in TMS measures was observed in ASD and CP. These results provide preliminary evidence that TMS-derived electrophysiological biomarkers may reflect critical developmental and pathological variations in cortical excitability and inhibition. While these findings represent preliminary evidence, they highlight the potential of TMS as a supportive tool for early clinical screening and offer valuable mechanistic insights that could eventually inform more personalized intervention strategies for pediatric neurological disorders. IMPLICATIONS: This meta-analysis provides preliminary evidence for the potential for the potential diagnostic utility of TMS-derived neurophysiological biomarkers in children and adolescents with neurological disorders. The diversity of TMS biomarkers and their observed relevance to disease -specific neuropathology suggest that TMS may offer a non-invasive, multidimensional approach to characterizing brain state in pediatric populations. While further large-scale studies are needed to confirm these trends, our findings offer insights that could eventually inform more precise clinical evaluation and early intervention strategies.
PMID: 42134566

**7.Linear and Curvilinear Sprint Performance Comparison in Footballers With and Without Cerebral Palsy**

Matías Henríquez, María Isabel Cornejo, Sebastián Norambuena-Meza, Alexis Espinoza-Salinas, Claudio Farías-Valenzuela, Rafael Lima Kons, Javier Yanci, Raul Reina

Percept Mot Skills. 2026 May 13:315125261452811. Online ahead of print.

Background: Cerebral palsy (CP) football is an adapted version of mainstream football in which para-athletes with neuromuscular impairments compete, characterized by intermittent physical demands such as linear and curvilinear sprints. Purpose: This study aimed to examine inter-limb performance during curvilinear running sprints by analyzing the differences and relationships between linear and curvilinear sprinting, and by comparing sprint performance between footballers with CP and able-bodied players. Research Design: A descriptive cross-sectional study was conducted, evaluating linear and curvilinear sprint capabilities. Study Sample and Data Collection Twenty-eight male football players completed a 17-m linear sprint and two trials per side of a curvilinear sprint for intra- and inter-group comparisons. Results: Significant differences were observed between footballers with and without CP in linear ($p < 0.01$) and curvilinear sprint performance on both the good ($p < 0.01$) and weak sides ($p < 0.01$). No between-group differences were found for the curvilinear sprint deficit ($p > 0.05$). Inter-limb comparisons during the curvilinear sprint test showed significant differences in time and velocity for both the CP group and CG ($p < 0.01$). Across both groups, 17-m linear sprint time was significantly faster than curvilinear sprint performance on either side ($p < 0.05$). A significant association was found between the good and weak sides in curvilinear sprint performance ($p < 0.01$). In the CP group, linear sprint performance was significantly associated with curvilinear sprints on both sides ($p < 0.05$), whereas no such association was found in the CG ($p > 0.05$).Conclusions: In conclusion, this study highlights inter-limb differences and reduced sprint performance in footballers with CP compared to an able-bodied group of players. Identifying specific differences in curvilinear and linear sprint performance may inform targeted training programs, support coaching and training decisions, and inform future classification research based on impairment-related performance effects.
PMID: 42126401

**8.Efficacy of Adding Lower Extremity Weights on Balance and Gait Disturbances in Children with Ataxic Cerebral Palsy: A Randomized Controlled Trial**

Nehad A Abo-Zaid, Heba A Khalifa, Tamer M Shousha, Mohamed Y Abdelsamee, Walaa E Heneidy

NeuroRehabilitation. 2026 May 13:10538135261444038. Online ahead of print.

Background: Ataxic cerebral palsy children have hard times controlling their movements. They exhibit tremors, shakiness and struggle with precise movements, balance as well as pattern of gait. Objective: To examine the influence of adding lower extremity weights on balance and gait disturbances in children diagnosed with ataxic cerebral palsy. Methods: Sixty children with ataxic cerebral palsy aged from 7 to 12 years participated in this trial after the eligibility assessment. They were randomly allocated to two equal sized groups. The standard care group underwent a designed treatment protocol, while the added weight group received the same designed treatment protocol along with adding lower extremity weights. Children in both groups underwent the same treatment protocols three times per week for a duration of three consecutive months. Biodex balance system and 3D motion analysis (3DMA) were used to evaluate stability indices as primary outcome (overall, mediolateral and anteroposterior), and spatiotemporal gait parameters as secondary outcome (speed, cadence, base width, step length, stride length, step time, and percentage of double support) respectively in both groups at the beginning and after three months of intervention. Results: Post intervention findings demonstrated a significant reduction in stability indices, base width, step time, and percentage of double support, as well as significant increase in walking speed, cadence, step length, and stride length, in both groups in favor of added weight group ($P < 0.05$).Conclusions: Adding small fixed lower extremity weights was associated with improvements in balance and reduced gait disturbances in ambulant ataxic cerebral palsy children.
PMID: 42125847

**9.Pain trajectories in children and adolescents with cerebral palsy: A longitudinal population-based register study**

May Phyu Sin, Johan Jarl, David L Roth, Ann I Alriksson-Schmidt

Dev Med Child Neurol. 2026 May 16. Online ahead of print.

Aim: To examine longitudinal trajectories of pain occurrence in children with cerebral palsy (CP) aged 1 year to 17 years.
Method: A longitudinal register-based study was conducted using data from the Swedish Cerebral Palsy Follow-up Program (2007-2023). Individuals (n = 4887) with confirmed CP, a minimum of three pain assessments, and any Gross Motor Function Classification System (GMFCS) levels were included (median age at baseline = 3 years 5 months; interquartile range = 4 years 2 months; males = 2864 [58.6%]; Communication Function Classification System levels I-III = 3158 [64.62%]). Pain reports indicated general pain in the past 4 weeks. Group-based trajectory modelling was applied.
Results: Four pain occurrence trajectories were identified: (1) increasing trend, low occurrence (probability of experiencing pain below 0.5 across all ages; 20.28%); (2) increasing trend, high occurrence (30.30%); (3) decreasing trend (26.85%); and (4) consistently high occurrence (22.57%). Compared to trajectory 1, individuals classified in GMFCS levels IV and V at baseline were more likely in trajectory 3 (log odd estimate = 0.56; standard error [SE] = 0.16) and 4 (estimated = 0.57; SE = 0.15), while females were more likely in trajectory 2 (estimated = 0.40; SE = 0.13) and 4 (estimated = 0.43; SE = 0.12).
Interpretation: Half of the children experienced high pain occurrence trajectories, while the rest showed low pain occurrence or improvement over time.
PMID: 42141804

**10.Oral Melatonin Supplementation for Sleep Disturbances in Children with Cerebral Palsy: A Randomized Double-Blind Controlled Trial - Correspondence**

Nirmal Kumar Mohakud, Manaswinee Sahoo

Indian J Pediatr. 2026 May 15. Online ahead of print.

Abstract
No abstract available
PMID: 42138798

**11.Sleep-disordered breathing in children with neurodisabilities**

Kristien Vanhaverbeke, Merve Selçuk, Refika Ersu, Hui-Leng Tan

Eur Respir Rev. 2026 May 13;35(180):250281. Print 2026 Apr.

Abstract
The prominence of sleep-disordered breathing (SDB) in children with neurodisabilities is increasingly becoming apparent. Patients can manifest not only obstructive sleep apnoea but also central sleep apnoea, nocturnal hypoxaemia and hypoventilation or often a combination thereof. The impact of SDB on quality-of-life measures has been increasingly demonstrated. This in turn is powering a paradigm shift, where investigation of SDB and subsequent treatment with surgical procedures or respiratory interventions, such as noninvasive ventilation, are increasingly considered in this cohort of patients, whereas historically they may not have been, given perceived barriers to successful treatment. In this review, we aim to summarise the literature on SDB in children with neurodisabilities published in the past two decades. We have concentrated on three main groups of children with neurodisabilities, namely those with cerebral palsy, those with inborn errors of metabolism where disease-modifying therapies are available for selected conditions and those with other genetic conditions resulting in significant neurodisability, such as Rett syndrome.
PMID: 42128483

**12.Long-term respiratory support in cerebral palsy: Defining benefit beyond physiological change**

Monica S Cooper

Dev Med Child Neurol. 2026 May 12. Online ahead of print.

Abstract
No abstract available
PMID: 42120970

**13.Respiratory disease in cerebral palsy: the overlooked impact of neonatal lung disease**

Natasha Bear, Katherine Langdon, Amanda Marie Blackmore, Noula Gibson, Lisa Moshovis, Andrew Wilson, Shannon Simpson

BMJ Paediatr Open. 2026 May 11;10(1):e004221.

Background: Respiratory disease is a leading cause of hospitalisations in children with cerebral palsy (CP). Over 40% of individuals with CP are born preterm; however, the relationship between prematurity, CP and respiratory disease is unknown.
Objectives: To establish the impact of gestational age (GA) and bronchopulmonary dysplasia (BPD) on respiratory hospitalisations in children with CP.
Study design: A 30-year (1986-2015) retrospective data linkage cohort study in children with CP.
Results: A total of 1915 individuals with CP (mean age 15 years and 5 months, 57% male) recorded 5566 respiratory admissions. Higher rates of respiratory admissions were seen in those born preterm (<37 weeks). Preterm infants with CP and BPD had 4.4 (incidence rate ratio 95% CI 3.3 to 6.0) times more respiratory-related admissions (after controlling for age, CP severity, epilepsy, speech impairment and gastrostomy) compared with individuals with CP born at term. Preterm infants with CP and BPD had respiratory-related hospitalisations at a younger age (median: 2 years 4 months vs term birth 20 years, $p<0.001$).
Conclusion: Preterm birth and BPD are risk factors for earlier and higher rates of respiratory-related admissions in individuals with CP. Perinatal and neonatal events should be considered when assessing respiratory health in CP.
PMID: 42114955

**14.Self-Care in Children and Young People With and Without Developmental Disabilities-A Systematic Review**

Lelanie Brewer, Ananya Namdeo, Elizabeth Rowen, Chizoba Oparah, Mark Pearce, Niina Kolehmainen

Child Care Health Dev. 2026 May;52(3):e70285.

Background: Looking after oneself (e.g., eating, keeping clean) and making decisions about how this is done ('self-care') is a key health outcome for children with a developmental disability, but guidelines are limited and support for children and families is variable. This systematic review investigated (1) factors influencing self-care in children and young people and (2) interventions that support self-care in children and young people with developmental disabilities.
Methods: Following PRISMA guidelines, a comprehensive electronic search of Medline (via Ovid) and CINAHL (via EBSCO) (2007-2024) was carried out. The protocol for this study was registered in PROSPERO. Studies and systematic reviews where self-care was the main outcome were selected. Data were extracted on participant and intervention characteristics, self-care outcomes and explanatory factors.
Results: Of the 16 586 studies screened, 115 were included (10 RCTs, 4 qualitative, 101 observational). These involved 14 590 participants, the individual study sample sizes ranging from 1 to 818 (median 64). The largest two studies (n = 818 each) were in children with cerebral palsy. Movement functions were the most frequently studied explanatory factor and showed consistent association with self-care, as did cognitive and executive function. Pain was investigated in two studies and sensory processing in one study, and both were consistently associated with self-care. Of personal and environmental factors investigated, age, socio-economic status, physical environment, accessibility and caregiver characteristics were associated with self-care. Interventions showing promise to improve self-care in those with developmental disabilities included adaptive seating, goal-setting training, motor skills training, educational programmes for primary caregivers and constrained-induced movement therapy. Overall, evidence about effectiveness is limited, and research has focused on children with cerebral palsy.
Limitations: Meta-analysis was not possible because of study heterogeneity.
Conclusions: The importance of movement and cognitive functions in self-care is well-established. Personal and environmental factors and intervention effectiveness require further research.
PMID: 42104859

**15.Wearable Devices for Bioelectrical Stimulation in Rehabilitation: Review of the Current State**

Jason Patrick Caffrey, Won Jae Jeong, Janet Del Rosario

Am J Phys Med Rehabil. 2026 May 12. Online ahead of print.

Abstract
Advancements in electrical stimulation technology, fabrication, and device design have led to the development of wearable bioelectrical stimulation devices, enabling rehabilitation in non-traditional settings. This scoping review evaluates the effectiveness of wearable bioelectrical stimulation devices for rehabilitation, providing an overview of the current state of clinical outcomes and prototype devices. A systematic search of MEDLINE was conducted on November 11, 2024, with additional relevant articles manually included. Studies were screened based on predefined inclusion and exclusion criteria. Out of 488 identified articles, 59 met the inclusion criteria. The categories represented were stroke (N=10), cerebral palsy (N=6), spinal cord injury (N=5), musculoskeletal (N=4), fibromyalgia (N=3), and peripheral neuropathy (N=3), in addition to other diagnoses (N=8), healthy participants (N=14), and non-clinically tested devices (N=6). Reported potential benefits of the devices included improvements in gait abnormalities, knee pain, low back pain, fibromyalgia, and bladder dysfunction, while outcomes in spasticity, neurological recovery, and circulatory augmentation remain inconclusive. Wearable bioelectrical stimulation devices have gained significant interest in the field of rehabilitation, with devices spanning many form factors to target a wide array of conditions. However, until further research provides clearer evidence, wearable bioelectrical stimulation devices should be considered an adjunct to established rehabilitation interventions.
PMID: 42132417

**16.A novel intelligent hybrid reinforcement learning framework for autonomous decision making in complex health cognitive systems**

Abdullah, Zulaikha Fatima, Muhammad Ateeb Ather, José Luis Oropeza Rodríguez

Sci Rep. 2026 May 11;16(1):14721.

Abstract
Existing reinforcement learning (RL) approaches struggle to balance real-time decision-making with adaptive learning in dynamic healthcare environments. We propose a brain-inspired hybrid RL framework that integrates model-based (MB) planning and model-free (MF) reflexes via a dynamic meta-controller, neuro-symbolic clinical knowledge, counterfactual reasoning, and ethical safeguards. The framework is validated on a multimodal cerebral palsy (CP) dataset (86 patients) using NetLogo multi-agent simulations and Weka classifiers. A combined reward mechanism achieves 99% total reward accumulation, with 98% optimal reward in 95% of training episodes. Component analysis shows a 60% MB / 40% MF contribution, yielding a 15% improvement over standalone methods. Optimal weighting (0.7 MB, 0.3 MF) further enhances performance. External zero-shot validation on three public datasets (NTNU-HARChildren, EEG-EMG exoskeleton, D4RL) confirms generalizability (macro F1 84.3%, accuracy 81.7%, D4RL scores 68.5 and 62.3). Regression methods achieve correlation coefficients up to 0.94, and classification models (multinomial Naïve Bayes, logistic regression) attain 100% precision, recall, and F-measure. The framework provides a reliable, explainable, and simulation-validated solution for patient-centric autonomous decision-making.
PMID: 42115656

**17.A feasibility randomised controlled trial of an exergaming device aimed at improving mobility in children with cerebral palsy**

Rachel Rapson, Bernie Carter, Harriet Hughes, Jos M Latour, Wendy Ingram, Jonathan Marsden

Digit Health. 2026 May 3:12:20552076261440965. eCollection 2026 Jan-Dec.

Aim: A novel interactive exergaming device enables children with cerebral palsy (CP) to exercise whilst standing. A small study showed gains in ankle motion after training with the device. This study explores the feasibility of a community-based randomised controlled trial (RCT) using this device to improve mobility in children with CP (Registered ISRCTN80878394).
Method: Fifteen children with CP Gross Motor Function Classification System (GMFCS) levels I-III were randomised 1:1 to either 10-weeks training with the device or usual care. Two potential primary outcome measures were assessed at 10-weeks with 20-week follow up: motion of the centre-of-mass estimate while stepping (Next Step) and Pediatric Balance Scale (PBS).
Results: Twenty-one children were assessed for eligibility, three declined to participate, two withdrew and one did not receive the intervention but remained in follow-up. Two serious adverse events occurred (n=2). Participant recruitment was 1.2 per month, limited by device availability. Completion of PBS and Next Step was 100% and 87% at baseline, dropping to 75% and 65% respectively at 10-weeks. The intervention group showed clinically meaningful changes in median (interquartile range) PBS at 10-weeks 2.7 (1) compared to the control 1.7 (0.67).
Conclusion: This study found multiple feasibility issues and further work is needed prior to implementing a RCT. There were signs of efficacy of the intervention, but findings are limited by small sample size.
PMID: 42109494

**18.Comparison of marker-based and markerless motion capture systems to assess gait kinematics and kinetics in children with cerebral palsy**

Raquel Costa, António Veloso, Filipa Joao

Gait Posture. 2026 Jul:128:110213. Epub 2026 May 7.

Background: Cerebral Palsy (CP) is a leading cause of childhood motor disability and is frequently assessed through clinical gait analysis using marker-based motion capture systems. However, these systems present challenges, such as errors regarding marker placement and soft tissue artifact. Markerless systems are a potential alternative that offer practical and technical benefits to perform gait analysis, by using computer vision and deep learning algorithms to overcome those limitations.
Research question: are there any differences between the joint angles, moments and powers, using both markerless and marker-based motion capture systems, when assessing gait kinematics and kinetics of children diagnosed with CP?
Methods: Fifteen children diagnosed with Cerebral Palsy (11 males, 4 females, aged 13.66 ± 1.72 years old) were submitted to a clinical gait analysis, captured with standard marker-based and markerless motion capture systems. The kinematic and kinetic variables were averaged and compared between the systems using RMSD and a two-tail paired sample t-test ($\alpha$=0.05).
Results: there is a consistent waveform and good agreement in sagittal plane kinematics, with Root Mean Square Difference (RMSD) < 6.0º, particularly for knee flexion. Nevertheless, hip flexion and pelvic tilt showed systematic offsets, and the transverse plane obtained more inconsistent measurements between the systems (RMSD > 10.0º), except for pelvic rotation.
Interpretation: Markerless system exhibits great potential for clinical gait analysis, and results suggest that joint kinematics in the sagittal plane are highly comparable. Accuracy improvements for estimations in other anatomical planes and regarding joint kinetics are still necessary, especially for the use of this technology in clinical settings.
PMID: 42107175

**19.Identification and Prioritization of Requirements for a Home-Based Tele-Rehabilitation Information System for Cerebral Palsy Patients: A Delphi Study**

Faridokht Salahshoori, Majid Jangi, Ebrahim Sadeghi-Demneh, Farhad Fatehi, Alireza Rahimi

Health Sci Rep. 2026 May 10;9(5):e71970. eCollection 2026 May.

Background and aims: The delivery of consistent and comprehensive rehabilitation care for Cerebral Palsy (CP) patients, particularly in limited-resource settings, faces significant structural, geographical, and economic barriers. The aim of the current study was to identify and finalize, through expert consensus, the functional and non-functional requirements of a home-based telerehabilitation information system for CP patients in the context of Iran, a setting with similar challenges to other low- and middle-income countries (LMICs).
Methods: A two-round Delphi methodology was employed with a multidisciplinary panel of experts to obtain a consensus regarding the requirements of a home-based telerehabilitation system. Based on a prior qualitative study and a scoping review, a comprehensive set of requirements was developed. Requirements with a mean score of ≥ 3.75 on a 5-point Likert scale or ≥ 80% agreement were included in the final framework. The ≥ 3.75 mean score was selected to represent a high consensus level, ensuring the average rating was clearly above the midpoint and toward the "Very Important" category (score of 5).
Results: A total of 142 requirements were identified and classified into 11 functional subsystems, comprising 121 functional and 21 non-functional requirements. The subsystems with the highest number of endorsed requirements were Remote Exercise Therapy (n = 22), Remote Education (n = 21), and Remote Counseling (n = 13). The most highly-rated non-functional requirements focused on Usability (e.g., simple interface), Compatibility (e.g., multi-device support), and Adaptability (e.g., future feature addition).
Conclusion: This study establishes a validated, context-sensitive framework for the development of a home-based telerehabilitation system for CP patients in Iran. By incorporating expert consensus across clinical and technical domains, the findings offer a strong foundation for future system design and implementation. The approach highlights the importance of tailoring digital health solutions to local needs and healthcare infrastructures, providing a model for similar LMIC settings.
PMID: 42125031

**20.Clinical Patterns of Cerebral Palsy in Pediatric Patients From Tertiary Referral Hospitals in Dubai, United Arab Emirates: A Retrospective Observational Study From 2018 to 2020**

Meera Almheiri, Alya Al Ameri, Hadi A Helali, Abdulla Alawadhi, Samar Almuntaser

Cureus. 2026 Apr 11;18(4):e106850. eCollection 2026 Apr.

Background Cerebral palsy (CP) is a neurological condition characterized by a combined impairment of posture, movement, and motor function, as well as potential sensory, neurological, and musculoskeletal problems. It is a chronic disorder caused by non-progressive aberrations in the evolving fetal or newborn brain. Objectives To examine the potential association between different comorbidities, genders, and clinical patterns associated with CP and to observe the prevalence of CP in Dubai, United Arab Emirates (UAE). Methods This was a retrospective observational study using previously collected data from 283 pediatric patients aged 18 years or younger diagnosed with CP at the Al Jalila Children's Hospital and Latifa Women and Children's Hospital. Data collection period spanned from January 1, 2018, to December 31, 2020. Data was analyzed using chi-square and proportion tests. Results Two hundred and thirty-one patients (89.9%) presented with spastic CP. Quadriplegia was the most prevalent type of spastic topography, which was found in 103 patients (44.6%), followed by diplegia (85 patients, 36.8%). Perinatal asphyxia was the most common etiology (150 patients, 52.7%). There was no statistically significant correlation between demographic data and the different comorbidities. Conclusions The study showed that spastic quadriplegia was the most common type of CP in this Dubai cohort. Perinatal asphyxia was the most common etiology.
PMID: 42124740

**21.Exploring the Psychosocial Impact on Families Caring for Children with Cerebral Palsy: A Qualitative Study in Saudi Arabia**

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Healthcare (Basel). 2026 May 6;14(9):1252.

Background: Parents of children with cerebral palsy (CP) experience several challenges in providing care, which can impact the child's quality of life. CP is one of the most common neurological conditions that demand a great deal of time and effort from caregivers. Purpose: To explore the psychological and social effects experienced by Saudi families while rearing children with CP. Methods: This research utilizes qualitative research methods. The purposive sampling method was used to select 13 caregivers of children with CP from the Children with Disability Association in Riyadh, Saudi Arabia. Personal interviews were conducted with a group of parents, then these interviews were analyzed to derive the experiences of the participants. Results: The findings highlighted the difficulties that these families go through from the moment the diagnosis was made, as well as other care burdens, including costs, isolation, and continuous anxiety and worries about the future of the children. Conclusions: This study identifies the need for organized psychological and social support, which has a significant impact on enhancing adaptability and the lives of the children.
PMID: 42121694

**22.Family-centered physiotherapy services for children with cerebral palsy in Syria: an observational study**

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BMC Pediatr. 2026 May 11. Online ahead of print.

Background: Children with cerebral palsy (CP) require long-term physiotherapy, and optimal pediatric rehabilitation should follow a family-centered framework that emphasizes respectful communication, shared decision-making, and comprehensive information. In Syria, healthcare disruptions and resource limitations may affect these elements, yet little is known about mothers' perceptions of family-centered physiotherapy services. This study assessed Syrian mothers' perceptions of physiotherapy services for children with CP and examined whether these perceptions varied by selected maternal, child, and service-related characteristics.
Methods: A cross-sectional survey was conducted at the Syrian Cerebral Palsy Center. Mothers of children aged 1-18 years who had received at least 3 months of physiotherapy were invited to participate, and 93 mothers were included in the final analysis. The Arabic version of the Measure of Processes of Care-20 (MPOC-20) was used to evaluate family-centered service behaviours on a 7-point Likert scale. Data were analyzed using SPSS version 23 with descriptive statistics, independent-samples t-tests, and one-way ANOVA. Statistical significance was set at $p < 0.05$.
Results: Overall, mothers rated Coordinated and Comprehensive Care most highly, whereas Providing General Information received the lowest ratings. Lower scores were also observed in domains related to information-sharing and partnership, indicating unmet needs in communication and shared decision-making. Mothers living in rural areas reported significantly higher scores for Providing General Information than mothers living in urban areas. Maternal age was significantly associated with Providing Specific Information, with younger mothers reporting lower scores than mothers aged 35-45 years. No significant differences were observed across child age groups. Treatment intensity was significantly associated with several MPOC-20 domains: mothers of children receiving physiotherapy more than twice per week reported higher scores in Enabling and Partnership, Coordinated and Comprehensive Care, and Respectful and Supportive Care, whereas Providing General Information was lower in this group.
Conclusions: Syrian mothers generally perceived physiotherapy services positively in domains related to coordination and supportive care; however, important deficiencies were identified in the provision of general and child-specific information and in parent-therapist partnership. Differences by maternal age, residence, and treatment intensity suggest that family-centered care may vary across subgroups. Efforts to strengthen caregiver education, structured information-sharing, and collaborative care planning may improve the family-centeredness of physiotherapy services for children with CP in this setting.
PMID: 42116027

**23.Adaptation of the International Standards for Anthropometric Assessment for Subjects With Motor Disabilities: A Consensus Statement of the ISAK Working Group on Motor Disability**

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Int J Sport Nutr Exerc Metab. 2026 May 15:1-11. Online ahead of print.

Abstract
The International Standards for Anthropometric Assessment (International Society for the Advancement of Kinanthropometry [ISAK]) have been developed and refined over a period of over 30 years in order to guide the landmarking and measurement of a wide range of surface anthropometrical variables in able-bodied individuals in order for such measures to be reliable, repeatable, and valid. While numerous researchers and practitioners have undertaken anthropometrical assessments on individuals with motor disability, there is a lack of consistency in the processes used, and the ISAK protocol currently does not guide adaptations for measurement or interpretation in this population. Therefore, the ISAK working group on motor disability has reviewed the literature and provided recommendations to follow when undertaking and interpreting anthropometrical assessments in individuals with a motor disability. Prior to undertaking any assessment, practitioners and researchers are encouraged to first consider the purpose and validity of what they wish to measure in each individual, as they present with their own unique characteristics. Most importantly, the safety and dignity of each individual must be respected.
PMID: 42140613

**24.Strategic consensus on the clinical translation of advanced therapies in paediatric rare neurological disorders**

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Neurotherapeutics. 2026 May 13;23(3):e00921. Online ahead of print.

Abstract
Advanced therapies (ATs), including gene and stem cell therapy, hold great potential for preventing and ameliorating many rare neurological disorders (RNDs) in children. These technologies are set to expand across modalities, potentially disrupting and augmenting conventional therapeutic pipelines, with the rapid pace of development highlighting data gaps and implementational challenges. We conducted a two-round modified Delphi study to co-develop a practice framework supporting the safe and effective application of advanced and/or experimental neurotherapeutics for children with rare neurological disorders within a public health ecosystem. The study generated 101 consensus recommendations encompassing criteria to 1) facilitate equitable and timely therapeutic access, 2) optimise transparent communication and shared decision making with families, 3) incorporate disease and patient level considerations for minimising risk and optimising safety within advanced therapeutic research, 4) strengthen resourcing of health systems to enable longitudinal evaluation of treatment effects and safety. Embedding this framework into practice will depend on enhancement of workforce training, establishment of digital infrastructure, fit-for-purpose clinical environments and education and engagement of patients, families and the broader community.
PMID: 42127456

**25.Health-State Utility Values in CP Patients Following Deformity Surgery: Are We Now Ready for Cost-Utility Analysis in This Patient Population?**

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J Clin Med. 2026 Apr 29;15(9):3398.

Background: Cost-utility analysis (CUA) is frequently used by reimbursement agencies and national advisory bodies to make informed decisions on whether or not to reimburse surgical interventions. Health state preferences (utilities) are a key component in valuing health outcomes in that they are used in calculating quality-adjusted life-years (QALY). Unfortunately, disease-specific HRQoL measures commonly lack the preference weights necessary to produce health-state utility values for use in CUA. A solution to this problem is to map a disease-specific quality-of-life measure to a generic preference-based measure. The aim of this study was to develop health-state utility values for cerebral palsy (CP) patients with scoliosis by mapping disease-specific quality-of-life scores (CPCHILD outcome questionnaire) to the Health Utility Index Mark 3 (HUI3) questionnaire. Methods: A prospective, multicentre CP scoliosis database was analysed identifying consecutive CP patients with ≥2 years follow-up who completed both the CPCHILD and HUI3 at enrolment, at 1-, and at 2 years follow-up. Ordinary least squared regression models were constructed to estimate HUI3 utility values from CPCHILD scores and clinical variables. The model was developed using enrolment data, while 1- and 2-years follow-up data were used for confirmatory analysis of the goodness of fit of the model (i.e., paired t test between observed and calculated HUI utility values). Results: A total of 232 patients were included, 91.9% were GMFCS IV and V, 87.9% underwent surgery during the study period, and the average magnitude of scoliosis deformity at enrolment was 81.93° ± 25.13°. A log-linear regression model was developed, including three predicting variables: CPCHILD total score (β = 0.016, p = 0.0001), communication (β = -0.436, p = 0.0001), and feeding ability (β = -0.289, p = 0.0001). The R2 of the model was 0.578, and F 49.73 (p = 0.0001). The mean difference of means between observed HUI3 values and calculated HUI3 values at 1- and 2 years was -0.020 (p = 0.129) and 0.017 points (p = 0.187), respectively. Conclusions: Although the use of a preference-based HRQoL measure is the ideal method to generate health-state utility values, we demonstrate that HUI3 scores can be accurately predicted using the CPCHILD questionnaire. This mapping algorithm will be useful in estimating health-state utilities in clinical trials, and hence CUA, of CP patients undergoing scoliosis surgery to help better inform patients, care-givers, health-care providers, and decision makers of the economic burden of surgery in this patient population.
PMID: 42123131

**26.Quality of Life and Mental Health Among Families Caring for Children with Medical Complexity: A Scoping Review**

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Healthcare (Basel). 2026 Apr 22;14(9):1124.

Background: Families caring for children with medical complexity (CMC) face sustained psychosocial demands that may impair health-related quality of life (HRQoL) and mental health. A clear map of how these outcomes are assessed and which factors shape them is needed to guide family-centered care. Methods: We conducted a scoping review following the Joanna Briggs Institute guidelines, and reports were prepared according to the PRISMA guidelines. Searches were conducted in PubMed, CINAHL, and EMBASE (January 2011 to December 2023) to find studies reporting on health-related quality of life (HRQoL) and/or mental health outcomes (anxiety, depression, burden) of family members and/or caregivers of CMC, including operationalization based on complex chronic condition (CCC) classifications, technology dependency, or the Pediatric Medical Complexity Algorithm (PMCA). Two reviewers independently screened records and recorded data, and the findings were synthesized narratively and thematically. Results: Sixty-seven studies met the inclusion criteria and spanned cross-sectional, cohort, case-control, pre-post and qualitative designs across conditions such as epilepsy, congenital heart disease, cerebral palsy, technology dependence and cancer. Common measures were PedsQL™ Family Impact Module, SF-36/12, HADS, Beck inventories and Zarit burden scales. Across the included studies, caregivers, predominantly mothers, frequently reported poorer HRQoL and higher levels of anxiety, depressive symptoms, or burden than comparison groups when these were available. Six recurrent themes emerged: (1) gendered caregiving with disproportionate maternal burden; (2) socio-economic gradients and financing models shaping outcomes; (3) culture, religion and spirituality as coping resources; (4) family and social support buffering distress; (5) school participation and coordinated services potentially reducing burden; and (6) interdependence between caregiver and child outcomes. Conclusions: Heterogeneous CMC definitions, outcome measures, and study designs limited comparability across studies. The mapped evidence suggests that family HRQoL and mental health outcomes are shaped by interacting clinical, social, and contextual factors. These findings may inform more family-centered and equity-oriented approaches to care. Future research should harmonize CMC definitions, standardize outcome measures, and prospectively evaluate multicomponent interventions.
PMID: 42121567

**27.The F-words for childhood development in community-based physical activity programmes for children with physical disabilities: A scoping review**

Belinda Munroe, Sarah Ashcroft, Suzanne Lock, Kylie Turner, Belinda Arnold, Sarah Reedman

Dev Med Child Neurol. 2026 May 11. Online ahead of print.

Aim: To identify intervention ingredients used to address the F-words for childhood development in community-based physical activity programmes for children with physical disabilities, the programme outcomes, and the strength of available evidence.
Method: A scoping review was conducted guided by the JBI Manual for Evidence Synthesis. Electronic database and hand searches of international literature identified studies that evaluated community-based physical activity programmes for children with a physical disability with impaired gross motor skills (e.g. sitting, walking) ranging from mild limitations in speed, balance, and coordination to severe impairment requiring the use of a wheelchair for mobility. Intervention ingredients were mapped to the six F-words: functioning, fitness, friends, family, fun, and future. Primary study outcomes were tallied and themed. Evidence strength was assessed using the Australian National Health and Medical Research Council guidelines and the Risk of Bias in Non-randomised Studies - of Interventions (ROBINS-I) tool.
Results: Twenty-four primary research articles were included. Most studies addressed the concept of functioning, fitness, fun, and friends, and few studies addressed family and future. Thirty common intervention ingredients were identified to deliver the F-words. Eight key outcome areas were identified. Most studies were level IV evidence and possessed a serious level of bias.
Interpretation: Despite identifying numerous intervention ingredients mapped to the F-words, the overall evidence base remains weak. Strengthening the quality and scope of research is essential to ensure the F-words framework is applied inclusively for physical activities across diverse populations of children with physical disabilities in community contexts.
PMID: 42116635

**28.Clinimetric evaluation of the 1-minute sit-to-stand test as a functional performance measure associated with quadriceps strength in children with spastic hemiplegic cerebral palsy**

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BMC Pediatr. 2026 May 11. Online ahead of print.

Purpose: To evaluate the construct validity, test-retest reliability, and clinical applicability of the 1-minute sit-to-stand test (1-MSTST) as a functional performance-based measure associated with quadriceps strength in ambulatory children with spastic hemiplegic cerebral palsy (GMFCS I-II). Despite its validity, instrumented strength assessment is not always feasible in routine pediatric rehabilitation, highlighting the need for simple functional alternatives.
Methods: In this cross-sectional methodological study with a test-retest design, 78 children aged 12-18 years were assessed. Quadriceps strength was measured using hand-held dynamometry. Functional performance was evaluated using the 1-MSTST, and a work score was calculated by multiplying repetitions by body weight. Construct validity was examined through correlations between work score and quadriceps strength.
Results: The 1-MSTST work score correlated strongly with affected limb strength ($r = 0.72$, $p < 0.001$) and moderately-to-strongly with the unaffected limb ($r = 0.65$, $p < 0.001$). Test-retest reliability was good (ICC = 0.78; 95% CI: 0.69-0.85). The standard error of measurement was 92.6 kg·repetitions and the minimal detectable change at the 95% confidence level was 256.7 kg·repetitions. No adverse events occurred. These findings indicate that the 1-MSTST is significantly associated with quadriceps muscle strength and may reflect functional lower limb performance, rather than serving as a direct measure of isolated muscle strength capacity.
Conclusion: The 1-MSTST is a valid, reliable, and clinically feasible tool for assessing functional performance related to quadriceps strength in ambulatory children with spastic hemiplegic cerebral palsy. It may serve as a practical complementary tool to instrumented strength assessment, particularly in routine and resource-limited clinical settings.
PMID: 42115985

**29.Bridging the Gap in Early Cerebral Palsy Detection: Primary Care Providers' and Specialists' Perspectives on Implementing PROMPTs for Referral**

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Child Care Health Dev. 2026 May;52(3):e70287.

Background: Cerebral palsy (CP) is the most common childhood-onset physical disability. Although diagnosis can be made within the first year of life, many children, particularly those with milder presentations, are diagnosed well after their second birthday. Delayed recognition limits access to early interventions and increases caregiver stress. The Early Detection and Intervention Toolkit for CP (EDIT-CP) was developed to bridge this gap, including PROMPTs for referral (Primary-care Referral of Motor-impaired children: Physician Tools) to guide early identification in primary care.
Objectives: This study aimed to explore how PROMPTs can be optimized and implemented across Canadian healthcare contexts. Specifically, we explored (1) primary care providers' perspectives on PROMPTs' feasibility, usability and integration into well-baby visits and surveillance tools; and (2) paediatric specialists' perspectives on referral patterns, age of diagnosis, barriers to early detection and system-level dissemination strategies.
Methods: In a qualitative study design, participants were first provided access to EDIT-CP and PROMPTs for referral for review prior to data collection. Semi-structured interviews were then conducted with primary care providers ($n = 11$), and a focus group ($n = 7$) and interviews with paediatric specialists ($n = 2$) to explore their perspectives on feasibility, usability, referral patterns and system-level implementation. Data were analysed using a hybrid inductive-deductive approach.
Results: Primary care providers highlighted the importance of clearer referral thresholds and pathways, with PROMPTs perceived as a useful facilitator. Specialists highlighted progress in earlier diagnosis for infants with high probability of CP, ongoing hesitancy to diagnose before age two and inequities in access. Both groups valued embedding PROMPTs for referral into existing workflows, emphasized the need for training and dissemination strategies and underscored the importance of communication with families.
Contribution: Findings show strong alignment among providers on the need for structured, practical and scalable early detection pathways. PROMPTs for referral extend early detection into frontline practice, offering a strategy to reduce diagnostic delays and promote equitable access to early intervention for children with CP.
PMID: 42108420

# Prevention and Cure

**30.Antenatal, pregnancy and delivery risk factors for infant cerebral palsy: an umbrella review of meta-analyses and systematic reviews**

Spinillo Arsenio, Mattia Dominoni, Martina Rita Pano, Cristina Angela Camnasio, Barbara Gardella, Chiara Cassani

Am J Obstet Gynecol MFM. 2026 May 12:101990. Online ahead of print.

Objective: To summarize the role of antenatal risk factors for infant cerebral palsy (CP) by un umbrella review.
Data sources: Pubmed, Cochrane list of trials, Medline and Google Scholar were searched for meta-analyses and systematic reviews, published between September 2009 and August 2025.
Study eligibility criteria: In all the studies included, the diagnosis of CP was made according to standard definitions after a minimum of two-year follow-up (PROSPERO N.XXXXXXXXXX).
Study appraisal and synthesis method: Results from primary studies were re-analyzed with dedicated software (Metaumbrella). The AMSTAR 2 checklist was used to determine the level of confidence in the meta-analyses' findings. Evidence strength was stratified into five categories: convincing, highly suggestive, suggestive, weak, and non-significant.
Results: A total of 35 meta-analyses, 16 systematic reviews, and 261 primary investigations, predominantly from developed countries, were included. The analysis assessed 54 antenatal, pregnancy, and delivery-related risk and protective factors, identifying 43 significantly associated with infant CP. Key antenatal risk factors included pre-pregnancy obesity (eOR=1.36, 95% CI=1.28-1.45, convincing evidence), smoking during pregnancy (eOR=1.32, 95% CI=1.22-1.44, convincing evidence), and singleton pregnancies from assisted reproductive technology (suggestive evidence). Among delivery-related factors, prematurity was the strongest risk, with odds inversely correlated with gestational age. Infants born before 32 weeks had the highest risk (eOR=40.8, 95% CI=32.3-51.6, highly suggestive evidence). Risk progressively decreased for infants born at 32-33 weeks (eOR=14), 34-36 weeks (eOR=3.49), and 37-38 weeks (eOR=1.62). Additional significant risks included a male fetus, maternal age >39 or <20, preexisting diabetes, alcohol exposure, low socioeconomic status, consanguinity, infections, twin pregnancies, preeclampsia, very-low birthweight, congenital anomalies, emergency cesarean section, operative vaginal delivery, and abnormal placental pathology. Protective factors included a single course of corticosteroids in preterm pregnancies (eOR=0.70, 95% CI=0.61-0.79, convincing evidence) and magnesium sulfate prophylaxis in very preterm deliveries (eOR=0.56, 95% CI=0.40-0.78, weak evidence). Indicated preterm delivery, rather than spontaneous, was also associated with reduced CP risk.
Conclusions: This analysis highlights the critical role of modifiable factors such as maternal obesity, smoking, alcohol use, and perinatal care in reducing the prevalence of CP. Prematurity remains a predominant risk, emphasizing the need for targeted prevention strategies.
PMID: 42128358

**31.PCYT1B-Targeting miRNAs as Potential Biomarkers for Placental Diseases**

Ha Eun Shin, Jin Seok, Jae Yeon Kim, Dong-Hyun Cha, Joong Sik Shin, Gi Jin Kim

Int J Mol Sci. 2026 Apr 30;27(9):4039.

Abstract
Obstetrical diseases are complications associated with pregnancy or childbirth that can cause maternal sequelae and fetal complications. Among them, preeclampsia (PE) and preterm labor (PTL) are major causes of premature birth and are associated with an increased risk of cerebral palsy, developmental delay, and hearing impairment in infants. However, reliable diagnostic markers and therapeutic strategies for obstetrical diseases remain limited. The aim of this study was to investigate genes associated with obstetrical diseases and to evaluate the correlation between phosphocholine cytidylyltransferase 1 beta (PCYT1B) and miRNAs targeting PCYT1B for diagnostic analysis in PE and PTL. Using miRNA array analysis and luciferase assays, we identified PCYT1B, a key enzyme involved in phosphocholine metabolism in reproductive tissues, together with several candidate miRNAs targeting PCYT1B, including miR-3065-3p, miR-4660, miR-6752-5p, miR-6842-5p and miR-7110-5p. qRT-PCR analysis revealed a significant correlation between PCYT1B and these miRNAs in placental tissues from patients with PE and PTL ($p < 0.05$). Immunofluorescence staining further demonstrated that PCYT1B was localized in the syncytiotrophoblast layer of placental tissues, and its protein expression was consistent with mRNA expression levels. To investigate the functional role of these miRNAs, trophoblast cells were treated with miRNA mimics and inhibitors. These treatments significantly altered trophoblast invasion capacity and regulated the expression of migration-related genes, including RhoA, Rac1 and ROCK. Collectively, our findings suggest that miRNAs targeting PCYT1B may regulate trophoblast function and may play a key role in placental development and obstetrical diseases. These results indicate that PCYT1B and its regulatory miRNAs could serve as potential biomarkers for PE and PTL and may provide insights into the development of miRNA-based diagnostic strategies.
PMID: 42123616

**32.Neurodevelopmental Trajectories in Preterm Neonates: Integrating Neuroimaging Modalities with Clinical Neurological Outcomes**

Andreea Ioana Necula, Roxana Pavalache-Stoiciu, Larisa Nicoleta Andrasoaie, Al Jashi Isam

Diagnostics (Basel). 2026 Apr 30;16(9):1356.

Abstract
This narrative review aims to demonstrate how integrating neuroimaging with functional assessments and standardised protocols enhances the identification of long-term motor and psychiatric risks. This review synthesized 12 studies from the last 5 years. The analysis focused on preterm infants (<37 weeks' gestational age) and evaluated the correlation between neuroimaging (head ultrasound (HUS) and Magnetic Resonance Imaging (MRI)), head circumference (HC), and functional assessments like Prechtl General Movements (GMs). While HUS remains the primary bedside tool, its sensitivity for subtle, non-cystic white matter injury is limited compared to MRI. Both modalities demonstrate high negative predictive values at term-equivalent age (TEA) for excluding severe motor deficits. Structural markers, including increased ventricular midbody size, immature gyration, and bilateral lesion laterality, were strongly associated with Cerebral Palsy (CP) and gross motor delays. Furthermore, TEA assessments provided superior prognostic accuracy compared to early neonatal scans. Optimal outcomes were linked to the integration of neuroimaging with functional assessments (GMs) and reliable parental support to ensure follow-up compliance. A tiered HUS/MRI protocol combined with routine GMs assessment enables precise prognostic counselling. Correlating TEA imaging with long-term findings necessitates follow-up beyond 24 months.
PMID: 42122059