Cerebral palsy research news

Monday 12 January 2026

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Interventions and Management

1.Which one is the most effective on the hand functions in hemiparetic cerebral palsy: constraint-induced movement therapy or constraint-induced movement therapy with virtual reality? A randomized controlled trial

Cetin Sayaca, Esin Kadıkoylu, Eren Demırayak, Ozden Ozkal, Filiz Eyuboglu, Mahmut Calık, Defne Kaya-Utlu

Arch Pediatr. 2026 Jan 6. Online ahead of print.

Background: Motor control of the upper limb is very important for play, personal care, and daily living activities. Losing the motor function of the hand limits the daily life activities, educational, and social participation of children with cerebral palsy (CP).
Objective: To compare the effects of constraint-induced movement therapy (CIMT) with virtual reality (CIMT+VR) use, only CIMT use, and traditional therapy (TT) on hand functions in children with hemiparetic Cerebral Palsy (h-CP).
Material and methods: Children who were h-CP would be divided into three groups randomly (TT, CIMT, CIMT+VR groups). Hand function and performance were evaluated with the Jebsen-Taylor and Moberg pick-up tests.
Results: Forty-five children participated in the present study. There were no differences in sex, affected side, age, hand function, or performance between groups. After six weeks of therapy, a difference in hand function was observed between groups. However, there were no differences in the functional performance of the hemiparetic hand after therapy.
Conclusion: Using CIMT and VR together improved hand functions, while there was no change in the functional performance of the hand.
PMID: 41500908

2.Characterizing Complex Upper Limb Movements with and without Visual Feedback in Typically Developing Children

Rachel L Hawe, Alexandria N Richardson, Triet Minh Lu

J Neurophysiol. 2026 Jan 6. Online ahead of print.

Abstract
The development of upper limb movements has been primarily described through reaching movements, which may not have the complex motor planning and execution demands of many daily tasks. In this study, we introduced a complex task in which individuals had to navigate their hand from a start target through two openings in a simple maze to reach an end target. In half the trials, participants received visual feedback of their hand position, and in half of the trials they did not. Thirty-one participants ages 8 to 17 years completed the study. We found that with visual feedback, reaction time, number of speed peaks, movement time, and hand path length all decreased with age. Number of speed peaks, movement time, and hand path length were all increased without visual feedback. Our results demonstrate that complex upper limb movements are refined across childhood and adolescence, potentially reflecting more anticipatory planning and feedforward control. This task can be applied to clinical populations such as cerebral palsy to assess impairments in motor planning and execution as well as determine how proprioceptive impairments contribute to complex movements.
PMID: 41494645

3.Impact of Growth Factors and Bone Age on BMD in Children and Adolescents With Cerebral Palsy

Marianne Lindblad Pedersen, Reem Zaabalawi, Nanette Mol Debes, Christina Engel Hoei-Hansen, Jesper Johannesen

Acta Paediatr. 2026 Jan 7. Online ahead of print.

Aim: Children with cerebral palsy (CP) have reduced bone mineral density (BMD) and increased risk of fragility fracture. Despite the critical role in skeletal development, no studies have examined insulin-like growth factor-1 (IGF-1) and insulin-like growth factor binding protein-3 (IGFBP-3), and their association with BMD in children with CP when adjusted for bone age. This study assesses the relationship between IGF-1 and IGFBP-3 and BMD in children with CP while accounting for bone age adjustment.
Methods: Cross-sectional study, 81 children with CP GMFCS I-V, aged 2-17 years (55.6% males), underwent clinical examination, DXA scan, blood sampling and bone age assessment. Regression analysis assessed associations between IGF-1, IGFBP-3 and BMD.
Results: Bone age was 0.64 years lower than chronological age ($p < 0.05$). Adjusted for bone age, BMD showed a positive association with IGF-1 ($p < 0.05$) and IGFBP-3 ($p < 0.05$). BMD z-score negatively associated with CP severity ($p < 0.05$) and CP severity was negatively associated with IGF-1 ($p < 0.5$) and IGFBP-3 ($p < 0.05$).
Conclusion: Children with CP had lower bone age than chronological age. BMD was positively associated with IGF-1 and IGFBP-3 adjusted for bone age. These findings are useful in growth hormone and osteoporosis treatment, such as Zoledronate, in CP.
PMID: 41498594

4.The motor optimality of infants who have had Meningitis in the first months of life: A retrospective study

Sophie Dixon, Samantha Ashby, Caroline Kuhne, Karen Ray, Larissa Korostenski, Katya Zawada, Anna Mistry, Rosemary Day, Michelle Jackman

Early Hum Dev. 2026 Jan 3;214:106477. Online ahead of print.

Background: Infants who have meningitis are at increased risk of adverse neurodevelopmental outcomes. Early screening tools can add value in identifying infants who may benefit from early intervention supports. The Motor Optimality Score Revised (MOS-R) is a relatively new tool used between 3 and 5 months of age that may have predictive value.
Aim: To describe the motor optimality of infants diagnosed with meningitis and determine whether the MOS-R is associated with development at 12 months of age.
Study design: A retrospective, single-center, cohort study from 2011 to 2023. The MOS-R was taken at 3-4 months corrected gestational age and development was assessed using the Bayley Scales of Infant and Toddler Development (Bayley) III/IV at 12 or 24 months of age.
Subjects: Participants included 73 infants (mean gestational age 37 + 3), admitted to hospital with meningitis before 4 months of age, who had a general movements assessment.
Results: Infants had a mean MOS-R of 22.3 (SD 3.29), with most infants in the study having MOS-R scores indicating mildly reduced optimality (78.8%). Significant positive correlations were found between MOS-R total scores and the receptive language, expressive language and gross motor domains of the Bayley III/IV. Infants with MOS-R scores <21 were more likely to show developmental delays in cognition, expressive language and receptive language.
Conclusion: For infants who had meningitis, MOS-R scores were associated with development at 12 months of age. The MOS-R, used in addition to GMA may have the potential to identify infants who would benefit from early intervention to support their development. Further research is needed to understand the use of the MOS-R, alongside other screening tools for populations at risk of adverse neurodevelopmental outcomes.
PMID: 41506216

5.Effects of balance training on different surfaces on ankle proprioception and functional balance in children with spastic cerebral palsy: a single-blind randomized controlled trial

Sabiha Bezgin, Kamile Uzun Akkaya, İlkan Çiçek, Yılmaz Akbaş, Bülent Elbasan

BMC Pediatr. 2026 Jan 3;26(1):3.

Background: Balance training on different surfaces is important in the rehabilitation of children with spastic cerebral palsy. However, the impact of balance training on different surfaces on ankle proprioception has not yet been investigated. This study aims to investigate the effects of balance exercises performed on rough and smooth unstable surfaces on ankle proprioception and dynamic balance in children with spastic cerebral palsy.
Methods: The study included 16 children aged 5-10 years with spastic hemiplegic and diplegic type cerebral palsy who were at the Gross Motor Function Classification System Level I and II. The children participating in the study were randomly assigned to two groups. One group performed balance exercises comprising six movements on a balance board for an average of 10 min following a 45-minute physical therapy session on a smooth surface, while the other group performed the same exercises on a rough surface. The intervention was conducted twice weekly for a duration of eight weeks. Balance was assessed using the Pediatric Balance Scale, the Functional Reach Test, and the Single Leg Stance Test. A digital goniometer was used to assess ankle joint proprioception.
Results: Significant improvement was observed in balance test scores in both groups. However, in the joint position sense tests for 15° dorsiflexion and plantar flexion on both the dominant and non-dominant sides, significant improvement was observed only in children who performed exercises on the rough balance surface ($p < 0.05$).
Conclusions: Balance training on unstable surfaces was found to be effective in improving balance parameters, with training on rough surfaces demonstrating greater efficacy than training on smooth surfaces in enhancing ankle proprioception.
PMID: 41485031

6.Neuromodulation techniques for enhancing lower extremity motor function in children with cerebral palsy (CP): a systematic review and meta-analysis of repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) interventions

Meysam Mansouri, Saba Amiri, Shahla Azizi

Review Disabil Rehabil. 2026 Jan 10:1-25. Online ahead of print.

Purpose: To evaluate the efficacy of repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) on gait and brain alteration in cerebral palsy (CP) children.
Materials and methods: MEDLINE, Scopus, Google Scholar, Web of Science, and Cochrane were searched in February 2024 and updated in 9 October 2025. Randomized controlled trials (RCTs) with CP participants under 18, rTMS or tDCS intervention, and gait assessment were included. The risk of bias was assessed, and a meta-analysis was conducted using random-effect models. This review was registered in PROSPERO (ID: CRD42024555049).
Results: 21 studies met the inclusion criteria. tDCS led to significant improvements in velocity (MD = 0.17, 95% CI = 0 to 0.35), gross motor function measure (GMFM), and functional independence. However, changes in other parameters such as step length, and cadence were not statistically significant and showed high heterogeneity. rTMS also improved overall motor function and walking performance in several studies, though data variability prevented meta-analysis. Both methods were safe and well-tolerated.
Conclusion: Both interventions showed promise for improving velocity and GMFM in children with CP. However, due to inconsistent findings across other gait parameters and substantial heterogeneity, further large-scale, standardized RCTs with neuroimaging assessments are needed.
Plain language summary: Transcranial direct current stimulation (tDCS) led to a significant increase in the velocity, Pediatric Evaluation of Disability Inventory (PEDI), and Gross Motor Function Measure (GMFM) of children with Cerebral Palsy (CP) Improvements in step length, stride length, and cadence after tDCS were non-significant and showed high heterogeneity.Repetitive transcranial magnetic stimulation (rTMS) improved GMFM scores, walking performance, and reduced spasticity, but data heterogeneity limited meta-analytic confirmation.Both neuromodulation techniques were safe and well-tolerated with only mild, transient side effects.Rehabilitation professionals should consider integrating tDCS or rTMS as supplementary therapies alongside traditional rehabilitation for children with cerebral palsy, while consistently monitoring motor progress using validated measures (GMFM, PEDI) and carefully tracking safety parameters.
PMID: 41518074

7.Do Authors and Editors Comply With Best Practice Reporting Guidelines for AFO Interventions in Studies Involving Children With Cerebral Palsy? A Scoping Review

Elaine Owen, Catherine Sarah June Hendy

Journal of Prosthetics and Orthotics. November 20, 2025.

Background: Ankle-foot orthoses (AFOs) are a widely used intervention. To improve reporting of designs and alignments, guidelines were established in 2010. Three key details to report are, ankle angle of AFO (AA-AFO), shank-to-vertical angle of AFO footwear combination (SVA-AFOFC), and any tuning or optimizing process undertaken, as these alignments are essential for maximizing the effectiveness of AFOFC interventions.
Objective: To evaluate the extent to which authors and editors adhere to reporting guidelines, specifically reporting of AA-AFO, SVA-AFOFC, and tuning or optimization.
Methods: A search was conducted, of eight databases, MEDLINE, CINAHL, PEDro, Embase, PubMed, CDSR, AMED, and Scopus, for articles related to 'ankle-foot orthosis' and 'cerebral palsy,' dates 2010 to July 2024. Records were screened to identify full text articles on AFOs designed to be rigid. A customized checklist was developed for data extraction.
Results: The search yielded 558 records, 64 were full text articles using AFOs designed to be rigid, published across 35 journals. Only nine reported all three parameters, two reported two parameters, and 21 reported one parameter. There was limited awareness of the two key alignments, and the need to individualize and optimize them for the individual. Comparison of AFO designs was often undertaken without controlling for alignments.
Conclusions: Despite reporting guidelines and international consensus advocating for comprehensive documentation, reporting of key parameters was found to be inconsistent and inadequate. This highlights the need for detailed reporting of AFO interventions. Improving rigor and quality has the potential to advance the field toward more effective and evidence-based interventions.
Clinical Relevance Statement: Inadequate reporting of AFO alignments, specifically ankle angle of the AFO, shank-to-vertical angle of the AFO footwear combination, and any individualization, tuning or optimization of these alignments, limits the ability to replicate and evaluate orthotic interventions, potentially compromising treatment.
Link to paper

8.Parental Concerns and Active Participation in Home-Based Vojta Therapy for Children with Global Developmental Delay: A Qualitative Study Using Interviews and Photo-Elicitation

Ana San-Martín-Gómez, Carmen Jiménez-Antona, María Salcedo-Perez-Juana, Livia Gomes Viana-Meireles, Domingo Palacios-Ceña

Healthcare (Basel). 2026 Jan 1;14(1):104.

Introduction: Parents of children presenting global developmental delay (GDD) need to be involved in their therapy to intensify treatment. Vojta therapy (VT) is an intensive physiotherapeutic treatment that can be administered at home. Whilst parental experience of Home-Based Program (HBP) for preterm or cerebral palsy is well documented, there is a lack of understanding about parents of GDD children on HBP with VT. Objectives: The aim of this work was to describe parents' perspectives concerning their participation in, concerns with, and perception of the results of an HBP with VT. Methods: A qualitative case design based on an interpretative approach was presented. A purposeful sampling was used. Data was collected in two stages: firstly, semi-structured interviews, and secondly, photo-elicitation. An inductive thematic analysis was used. Results: Seventeen parents were included. Three themes emerged from parents' perspectives. Firstly, parents' active participation in VT, which includes their desire to become an active agent to contribute to their child's improvement, their implication of compromise, learning process, time required, effort, and factors that influence their adherence and continuity. Secondly, parents' perception of the results achieved: motor improvement and better resting, feeding, and breathing; and time and commitment required to achieve them. Thirdly, parents' initial concerns about suitability, daily implementation, therapy functioning, or evidence, as well as concerns about emotional bonds. Conclusions: Parents universally perceive that their commitment and efforts were rewarded. They recognized that the emotional bond with their child was strengthened by the therapy. The results regarding the beneficial effects perceived by the parents should be treated with caution, as no instruments for assessing the effect or efficacy were used in this study.
PMID: 41517035

9.Parasports for cerebral palsy: Thinking and 'prescribing' beyond the Paralympics

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508309

10.Exploring Engagement as a Key Ingredient in the Efficacy of CIMT and HABIT Interventions for Children with Unilateral Spastic Cerebral Palsy

Dalina Delfing, Karen Chin, Jaya Rachwani, Kathleen M Friel, Victor Santamaria, Christine Imms, Andrew M Gordon

Phys Occup Ther Pediatr. 2026 Jan 6:1-18. Online ahead of print.

Aims: Person-level engagement, though well studied in counseling, mental health, and adult rehabilitation, is also critical in pediatric rehabilitation, yet it remains underexplored in motor learning interventions for children with unilateral spastic cerebral palsy (USCP). This study investigated how individual characteristics, including age and mastery motivation, influenced person-level engagement and examined how engagement affected motor outcomes.
Methods: A retrospective analysis was conducted involving 49 children with USCP aged 6-17 years who participated in either constraint-induced movement therapy (CIMT) or hand-arm bimanual intensive therapy (HABIT). Engagement was assessed through video coding and behavioral questionnaires, while hand function was evaluated using three standardized tests.
Results: Findings indicated that age was significantly related to engagement. Engagement measures correlated with improvements in hand capacity as measured by the Jebsen-Taylor Hand Function Test, but not with performance on the Assisting Hand Assessment.
Conclusion: The results highlighted the relationship between age and engagement, emphasizing the importance of age-appropriate intervention strategies. Engagement played a role in improvements observed on capacity-based hand function tests, suggesting that engagement during therapeutic camps may be more critical for capacity-based than for performance-based motor activities. These insights support the design of targeted, age-appropriate interventions that optimize therapeutic outcomes for children with USCP.
PMID: 41492798

11.Contralateral C7 nerve transfer combined with human acellular nerve allograft as a viable strategy for spastic upper limb paralysis

An Jiang, Liwei Yan, Zhenpeng Li, Changying Zhao, Jintao Fang, Jingyuan Fan, Bengang Qin, Canbin Zheng, Qingtang Zhu, Honggang Wang

Eur J Med Res. 2026 Jan 5. Online ahead of print.

Background: Peripheral nerve surgery is a potential treatment for chronic spastic hemiplegia, but the role of contralateral C7 nerve transfer combined with human acellular nerve allograft remains to be explored. This study aimed to investigate the functional outcomes of contralateral C7 nerve transfer combined with human acellular nerve allograft for spastic upper limb paralysis.
Methods: From January 2020 to December 2023, 53 patients with unilateral spastic upper limb paralysis completed a 12-month follow-up. 17 patients underwent contralateral C7 nerve transfer combined with human acellular nerve allografts, while 36 received rehabilitation alone. The primary outcome was the change in the Fugl-Meyer Assessment. Safety outcomes included adverse events and changes in muscle strength and motor-sensory function assessment of the arm and hand on the side of the donor C7 nerve.
Results: The overall Fugl-Meyer Assessment increased by 15.88 ± 3.54 in the surgery group and 2.36 ± 2.34 in the rehabilitation group (difference, 13.52, $P < 0.001$). Spasticity improvements were observed on the Modified Ashworth Scale for various muscle groups ($P < 0.001$). Adverse events related to the donor nerve included mild numbness in the radial three digits, slightly weakened triceps brachii strength, and tolerable peripheral neuropathic pain. No other adverse event relative to the bilateral brachial nerve occurred except for the C7 nerve section, and all events resolved within 3 months for all patients.
Conclusion: Our study suggests that the combination of the contralateral C7 nerve transfer and the human acellular nerve allograft may be a viable treatment option for individuals experiencing long-term spastic upper limb impairment following chronic cerebral hemisphere injury.
PMID: 41492141

12.Eating and drinking abilities and nutritional status in children with cerebral palsy: A population-based study

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508552

13.Abdominal tuberculosis presenting as a massive lower GI bleed in a cerebral palsy patient—a case report

Alexander M Kravets, Dzhastyn Dkhillon, Zachary Gross, Sholom-Ber Chernyak, Eugene Tarasov

J Surg Case Rep. 2026 Jan 7;2026(1):rjaf1029. eCollection 2026 Jan.

Abstract
Abdominal tuberculosis is a rare extrapulmonary manifestation of tuberculosis (TB), one that is increasingly encountered at hospitals serving a growing immigrant population. Since the COVID-19 pandemic, the incidence of TB has continually increased. The diagnostic differential often overlaps with inflammatory bowel disease, with diagnostic laparoscopy remaining the most effective modality of diagnosis. Additional diagnostic difficulties are encountered in patients unable to report symptoms. We present the case of a 52-year-old woman with cerebral palsy who presented initially with pulmonary symptoms and later developed massive lower gastrointestinal bleeding. Conservative management was attempted with angioembolization of a bleeding cecal mass on computed tomography. The patient initially improved and then decompensated after several hours. The patient then underwent emergent exploratory laparotomy for resection of a bleeding ileocecal mass which was found to be abdominal tuberculosis on pathology.
PMID: 41503125

14.A Case of Verrucous Carcinoma of the Bladder in a Patient with Cerebral Palsy

Mao Saito, Narihiko Kakoi, Miyuki Izumi, Hiroshi Aoki

Hinyokika Kiyo. 2025 Dec;71(12):425-428.

Abstract
A 50-year-old man with cerebral palsy presented to our department complaining of pollakiuria and macrohematuria. Although urinary cytology revealed no positive findings, computed tomography (CT) showed muscle-invasive bladder carcinoma and right intrapelvic lymphadenopathy (cT3bN1M0). Cystoscopy revealed a large non-papillary bladder tumor. Radical cystectomy and urinary diversion were performed. Verrucous carcinoma (VC) of the bladder without intrapelvic lymph node metastasis (pT3bN0) was diagnosed histopathologically. VC is often locally invasive and is a non-metastasising well-differentiated variant of squamous cell carcinoma. Patients with cerebral palsy have a high incidence of urinary incontinence, dysuria, and urinary tract infections. VC of the bladder is associated with chronic bladder irritation due to various causes, including chronic cystitis, dysuria, and bladder stones. VC is frequently detected as locally invasive disease of stage T3 or higher; the only effective treatment is radical cystectomy. Therefore, early detection and surgery are necessary to improve prognosis. Clinical evaluation, including urodynamic studies, is recommended for patients with cerebral palsy, and in cases of persistent pollakiuria, dysuria, and macrohematuria, abdominal CT and cystoscopy should be considered for the early detection of squamous cell carcinoma and VC of the bladder.
PMID: 41486005

15.Short Mobile Training Is Effective and Efficient in Preparing Educational Personnel to Interact With Students With Cerebral Palsy Who Utilize Augmentative and Alternative Communication With Eye Tracking

Dawn J Sowers, Janice Light, Erik Jakobs, Julia Olkin, Kristina Exton, Holly Panfil, Julie Conway, Maggie Lamb

Lang Speech Hear Serv Sch. 2026 Jan 9:1-9. Online ahead of print.

Purpose: The purpose of this study was to determine the effectiveness of a short tablet-based training for educational personnel working with students with cerebral palsy who use augmentative and alternative communication (AAC).
Method: The study used a pretest-posttest control group design; participants (N = 12) were quasirandomly assigned to a training or control group. All participants completed two separate interactions with one of two students who used AAC (Time 1 and Time 2). Between the two interactions, the training group viewed a short, self-paced, mobile training (using the INSTRUCT application), which included a checklist and video modeling to teach the school staff a strategy to interact more effectively with students who used eye-tracking AAC devices. The INSTRUCT platform was specifically designed for the creation and delivery of high-quality AAC-related training to communication partners. The control group did not complete the training. The pre- and post-interactions (Time 1 and Time 2) were video-recorded and analyzed to determine the communication partners' use of the steps of the target strategy. Gain scores from Time 1 to Time 2 were calculated for each participant; an independent t test was used to compare gain scores between the control and training groups. A secondary analysis looked at the frequency of communication turns by the student that included content beyond a yes/no response or selecting from a binary choice to contribute to the interaction.
Results: The training provided within the INSTRUCT platform resulted in the educational personnel increasing their use of the target strategy in comparison to those who did not receive the training; the difference was statistically significant ($t = -6.21$, $p < .01$). Moreover, the students who used AAC also demonstrated increased communication with the staff in the training group.
Conclusions: The study found the short mobile training delivered in the context of the INSTRUCT app was effective in shaping the interaction behaviors of the educational professionals. These findings suggest that quick, focused trainings can be an effective means to teach communication partners strategies to support interactions with students who use AAC.
PMID: 41511873

16.A machine learning study highlighting the challenges of fidgety movement recognition using vision and inertial sensors

Falco Lentzsch, Frédéric Li, Friederike Pagel, Margot Lau, Andrea Kock, Hanna Marie Röhling, Anne Stein, Maciej Baranowski, Marco Maass, Hannes Hölzl, Sebastian Glende, Sebastian Mansow-Model, Ute Thyen, Marcin Grzegorzek

Sci Rep. 2026 Jan 5;16(1):459.

Abstract
Past medical research has shown that infantile movement and early neurological development are closely linked. Fidgety Movements that are reflex-like movement occurring in healthy infants less than 20-week of age have proven to be especially important, as past studies have highlighted that their absence is strongly correlated with the future development of neurological disorders like Cerebral Palsy. To provide a timely intervention, the General Movement Assessment was proposed as a screening medical procedure carried out by clinical personnel specifically trained to recognize Fidgety Movements. Because of its high cost in time and resources, several initiatives to automatize General Movement Assessment using machine learning techniques have been proposed in the literature. However none has managed to emerge as state-of-the-art so far. To investigate this problem, we conducted a study using deep learning approaches to learn disentangled feature representations for the recognition of Fidgety Movements using RGB-D video and Inertial Measurement Unit data acquired from 95 infants (average age: [Formula: see text] weeks). Our results show that while it is possible to learn features that characterize movement independently of subject information, obtaining feature representations that consistently generalize to subjects unseen during training remains challenging. More specifically, we observe that both the vision- and sensor-based modalities have specific challenges to be addressed for the recognition of Fidgety Movements. We discuss them and provide recommendations to help researchers interested in investigating this problem in the future.
PMID: 41490995

17.Multimodal Motion Capture Toolbox for Enhanced Analysis of Intersegmental Coordination in Children with Cerebral Palsy and Typically Developing

Ligia Yumi Mochida, Paulo R P Santiago, Miranda Lamb, Guilherme M Cesar

J Vis Exp. 2025 Dec 16:(226).

Abstract
Three-dimensional marker-based motion capture systems are the gold standard for evaluating kinematic patterns in human movement, offering precise quantification of segment and joint positions. However, traditional marker-based systems pose several challenges, particularly for children with neurological disabilities and sensory processing abnormalities, such as those observed with children with cerebral palsy. These challenges hinder the use of kinematic markers and limit detailed analyses of movement patterns. Recent advancements in markerless motion capture systems utilizing deep learning-based human pose estimation allowed us to explore cost-effective alternatives to traditional optical systems and the subsequent data processing approaches. An integrated toolbox was developed, combining multiple motion capture technologies: research-grade kinematic equipment, kinematic clusters, inertial measurement units, three-dimensional (3D) markerless systems, and two-dimensional (2D) markerless systems with commercially available cameras (via MediaPipe). For this current study, we present the outcomes of 3D marker-based versus 2D markerless motion capture, the major ongoing issue in human subjects' biomechanical studies, to describe coordinative patterns via hip-knee angle-angle plots. The cyclogram approach was selected because it offers a robust metric and readily interpretable framework for analyzing coordination via coupled motion between body segments. Two typically developing children and two children with cerebral palsy performed a functional movement pattern, the sit-to-stand task. The findings here demonstrated the feasibility of integrating multimodal systems for kinematic analyses, providing flexibility for research and clinical settings. Moreover, the novel open-source approach presented in this work addresses the challenges posed by many patient populations experiencing sensory processing issues, allowing for an advanced and individualized plan of care.
PMID: 41490048

18.Perspectives of people with cerebral palsy and communication partners about eye-gaze control technology opportunities and service provision in Australia: a qualitative study

Sonia Elliott, Margaret Wallen, Michelle McInerney, Avril Parry, Petra Karlsson

Augment Altern Commun. 2026 Jan 5:1-11. Online ahead of print.

Abstract
Eye-gaze control technology (EGT) can facilitate communication and participation for people with physical disabilities or those who use augmentative and alternative communication (AAC). Clinical guidelines for EGT in cerebral palsy (CP) were published in 2021, but users' perspectives on service provision and outcomes remain underexplored. This study aimed to investigate these perspectives in the Australian context. Using a qualitative descriptive approach, semi-structured videoconference or email interviews were conducted with three adults with CP who use EGT and four communication partners. Data were analyzed using reflexive thematic analysis. Two themes were derived: 'EGT Has Opened the Doors for Us' and 'Navigating the EGT Journey', with subthemes 'The Integral Role of Support Systems' and 'Building Skills and Confidence'. Participants described how EGT enabled previously inaccessible forms of communication and participation, fostering autonomy and social connection. They also reported inconsistencies in assessments, trials, and support. Implementing EGT was characterized as a long and complex journey, involving challenges such as navigating funding systems, managing technical issues, and building skills and confidence. Findings revealed that access to EGT alone was insufficient; outcomes were shaped by the consistency of support, clinician expertise, and opportunities for users to build confidence over time. This study highlights the need for consistent application of EGT clinical guidelines to ensure equitable access, while allowing flexibility in how and when ongoing support is provided, reflecting user priorities and the complexity of EGT implementation in practice.
PMID: 41489569

19.The lived experiences of parents of children with cerebral palsy. A phenomenological study in a tertiary care facility, Ghana

Ruth Nkpezah Nimota, Ndekugri Damata Huldah Atame, Kennedy Diema Konlan

J Pediatr Nurs. 2026 Jan 8;87:78-87. Online ahead of print.

Introduction: Cerebral palsy is a group of permanent movement disorders that appear in early childhood, affecting muscle tone, posture, and movement. This study explored the lived experiences of parents of children with cerebral palsy.
Method: A phenomenological qualitative research approach was used to collect data from parents of children with cerebral palsy. Interviews were conducted with purposely selected parents of children until data saturation at the 13th interview. Data was analysed using thematic analysis. Four themes were identified and included: 1) burden of caring for children with cerebral palsy, 2) impact of diagnosis on family and other socioeconomic factors, 3) coping mechanisms and support systems, and 4) factors influencing care experience.
Results: Parents reported significant physical, emotional, and financial burdens associated with caring for children with cerebral palsy and relied on personal resilience, support from family and friends, and faith-based practices to manage their stress. Parents reported positive and supportive relationships with healthcare professionals. Access to support groups, community resources, and specialized services varied significantly among participants, impacting their ability to manage their child's condition effectively. Parents with better access to these resources reported a higher quality of life and better coping mechanisms.
Conclusion: This study underscores the need for improved healthcare practices and policies to prioritize comprehensive support for families of children with cerebral palsy.
Implications to practice: Key strategies for supporting parents of children with cerebral palsy included establishing structured routines, effective planning and organization, prioritising self-care, seeking social support, utilizing professional help, and maintaining flexibility.
PMID: 41512594

20.Participation in activities of daily living after the Akwenda Intervention Program for children and young people with cerebral palsy in Uganda: A cluster-randomized trial

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No authors listed
PMID: 41508318

21.Cerebral palsy in Brazil: A multicentre, cross-sectional, descriptive study

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508282

22.Predictors of dental caries in children and adolescents with cerebral palsy (CP): a cross-sectional analytical study in Malaysia

Narjit Kaur Paramjit Singh, Ahmad Shuhud Irfani Zakaria, Haslina Rani, Khoo Teik Beng, Alida Mahyuddin

Transl Pediatr. 2025 Dec 31;14(12):3398-3408. Epub 2025 Dec 24.

Background: Children and adolescents with cerebral palsy (CP) are known to have higher dental caries prevalence due to interacting clinical, behavioral, and socioeconomic factors. Although caregiver burden and suboptimal oral health practices have been implicated, their relative contributions remain unclear. This study aimed to determine caries prevalence in children and adolescents with CP, assess caregiver burden, and identify key predictors of increased caries risk.
Methods: This cross-sectional analytical study was conducted across two hospitals in Kuala Lumpur. Clinical data, including the Gross Motor Function Classification System (GMFCS) levels and CP subtypes, were extracted from patient medical records. Dental caries prevalence was assessed using the Decayed, Missing, and Filled Teeth (DMFT)/decayed filled teeth (dft) index, while caregiver burden was measured using the Zarit Burden Interview. Binary logistic regression was used to identify predictors of dental caries prevalence.
Results: A total of 110 children and adolescents with CP and their caregivers participated in the study. The prevalence of caries in primary teeth (70.3%) was consistent with the national average (71.3%). However, for permanent teeth (77.3%), it was over twice the national caries prevalence (33.3%) in 12-year-old children. The Care Index was notably low for both primary and permanent teeth at 6.1% and 20.0%, respectively. On average, caregiver burden was mild to moderate. Binary logistic regression revealed that children with GMFCS levels IV and V were 25.1 times [95% confidence interval (CI): 4.54–138.90] more likely to exhibit dental caries than those at GMFCS levels I–III.
Conclusions: This study demonstrates that children and adolescents with CP experience high caries prevalence and unmet dental treatment needs. On average, the caregivers experience mild to moderate burden and severe motor impairment (GMFCS IV–V) is the sole key predictor of caries risk in children and adolescents with CP. Hence, the GMFCS classification serves as a reliable tool for stratifying caries risk in children and adolescents with CP. Targeted dental caries prevention, early intervention, regular monitoring, and multidisciplinary care involving pediatricians, rehabilitation teams and the pediatric dental team are imperative to improve oral health outcomes.
PMID: 41502901

23.Effect of nursing-led empowerment program on care burden and social isolation among caregivers having children with cerebral palsy: A quasi-experimental study

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J Pediatr Nurs. 2026 Jan 8;87:88-98. Online ahead of print.

Background: Cerebral palsy is a lifelong, non-progressive neurodevelopmental disorder that affects movement and posture, often resulting in long-term disability. Caregivers-most commonly mothers-assume primary responsibility for daily care and rehabilitation, which can lead to a high care burden and increased social isolation. Aim: To evaluate the effect of a nursing-led empowerment training program on care burden and social isolation among caregivers of children with cerebral palsy. Methods: A quasi-experimental pretest-posttest design was conducted with a convenience sample of 98 caregivers assigned to an intervention group (n = 49) or a control group (n = 49). Data were collected using the Caregiver Burden Inventory, the Revised UCLA Loneliness Scale, and the Family Empowerment Scale. The intervention group participated in a six-session nursing-led empowerment program over six weeks, while the control group received routine care. Outcomes were assessed before and after the intervention. Results: Post-intervention, caregivers in the intervention group showed a significant reduction in care burden and loneliness scores and a significant increase in family empowerment scores ($p < 0.001$ for all). The control group showed no significant changes in care burden or empowerment and a significant increase in loneliness scores ($p < 0.05$). Conclusion: The nursing-led empowerment program effectively reduced care burden and social isolation while enhancing empowerment among caregivers.
PMID: 41512595

24.Potential Role of Serum Cytokines and Chemokines as Biomarkers of Injury Severity and Functional Outcomes Following Pediatric Traumatic Brain Injury

Kathryn Swaby, Alexander J Skirvin, Natalie Machado, Maria Mateo Chavez, Julia Alexis Bernal, Ana Fuentes, Charlene P Pringle, Kourtney Guthrie, Jennifer Coto, Rajderkar Dhanashree, Joslyn Gober, Paula Karina Perez, Juan P Solano, Heather J McCrea, Ricardo Loor-Torres, Joyce Kaufman, Ayham Alkhachroum, Kristine H O'Phelan, Firas Kobeissy, Robert W Keane, Kevin K Wang, W Dalton Dietrich, Juan Pablo de Rivero Vaccari, Jennifer C Munoz Pareja

Cells. 2025 Dec 22;15(1):19.

Abstract
Traumatic brain injury (TBI) is one of the leading causes of death and neurological disability worldwide. The search for biomarkers that indicate TBI severity and prognosis with greater accuracy is ongoing. This study aimed to evaluate the significance of several neuroinflammatory cytokines and chemokines, assessing their potential as biomarkers in pediatric TBI (pTBI). This was an exploratory analysis of inflammatory cytokines and chemokines measured in a subset of 26 children aged 0-18 years with TBI and 21 controls. TBI severity was determined by GCS. The functional outcome was measured via the GOS-E score at 6 weeks and 3, 6, 9, and 12 months post-injury. Serum samples were analyzed for ICAM -1, VCAM-1, SAA, CRP, IFN-g, IL-10, IL-12p70, IL-13, IL-1b, IL-2, IL-4, IL-6, IL-8, TNF-a, TNF-b, eotaxin, eotaxin-3, IP-10, MCP-1, MCP-4, MDC, MIP-1a, MIP-1b and TARC. Levels of IL-6, IL-10, IL-13, IL-16, MDC, and GM-CSF were increased, and IFN-γ, IL-5, IL-8, and eotaxin-3 were decreased at enrollment when compared with controls. Elevated IL-6 and IL-10 at enrollment were associated with severe TBI (AUC of 1, $p = 0.0002$ and $p = <0.0001$, respectively). IL-6, IL-10, IL-16, and TNF-β at enrollment and IL-5 at 24 h were elevated in children with unfavorable outcomes, with an AUC > 0.8, suggesting biomarker potential. Our data indicate that several cytokines and chemokines measured after TBI may aid in the assessment of pTBI severity and prognosis. IL-6, IL-10, and IL-16 may show potential as biomarkers for pTBI severity and outcomes.
PMID: 41511302

25.Parent and Therapist Perceptions of Early Therapy for Infants With or at Risk of Cerebral Palsy: A Scoping Review

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Child Care Health Dev. 2026 Jan;52(1):e70232.

Background: Currently, the early detection of cerebral palsy (CP) or risk of CP is recommended to enable targeted and specific intervention. The provision of early therapy is a complex practice that places high demands on both parents and therapists. More knowledge about the perceptions of parents and therapists is needed to help the implementation of family-centred early therapy interventions that are based on recent evidence in clinical practice. This scoping review aims to identify the extent of literature and summarize the evidence exploring parents' and therapists' experiences of early occupational and physical therapy for infants with or at risk of CP.
Method: The scoping review was conducted in accordance with the JBI methodology for scoping reviews and reported following the PRISMA Extension for Scoping Reviews checklist. The experiences of parents and therapists were categorized using qualitative content analysis.
Results: In total, 16 studies published between 2018 and 2024 were included. Parent-reported experiences were included in 15 studies and therapist-reported experiences in three. The content analysis resulted in five categories reflecting perceptions of valued and challenging aspects of early therapy. Four categories concerned parents' perceptions: parental commitment, parent-therapist collaboration, parents as training providers and parental education. One category concerned therapists' perceptions: providing guidance and educating parents.
Conclusion: Insight into perceptions of early therapy highlights the importance of professional coordination of intervention, specific training of therapists, managing parents' feelings of uncertainty and balancing parents' engagement in their role as treatment providers and the pressure they may experience from the responsibility this role entails. This finding contributes important knowledge for the successful implementation of family-centred and evidence-based early therapy interventions in clinical practice for infants with or at risk of CP. A limited number of studies exploring therapists' perceptions were identified, which indicates a knowledge gap and a need for further research.
PMID: 41511283

26.Understanding and Managing Infantile PHGDH Deficiency: A Case Report

Mayank Nilay, Rani Manisha, Dharmendra Kumar Singh

Neurol India. 2026 Jan 1;74(1):115-118. Epub 2026 Jan 9.

Abstract
Phosphoglycerate dehydrogenase deficiency is a rare neurometabolic disorder with clinical features of congenital microcephaly, psychomotor retardation, intractable seizures, and spasticity. We report a 2.5-year-old boy presenting with speech delay, seizures, microcephaly, and hyperactive behavior. Genetic testing detected a likely pathogenic homozygous variant c.1129G>A in the PHGDH gene. Parents were carrier for the detected variant. Biochemical analysis showed low serine and treatment with oral serine and glycine resulted in seizure control, followed by catchup of developmental milestones. This case illustrates the need for evaluating underlying neurometabolic causes, particularly treatable entities, in clinical presentations similar to cerebral palsy.
PMID: 41510869

27.The Right to Know About CMV-Perspectives of Pregnant Women and Families With Lived Experience of CMV

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Rev Med Virol. 2026 Jan;36(1):e70096.

Abstract
Cytomegalovirus (CMV) is a common herpesvirus that is transmitted from person to person via bodily fluids, including urine, saliva, blood and semen. If a pregnant woman acquires CMV for the first time (maternal primary infection) or has CMV reactivation or reinfection with a new strain in pregnancy, a resulting congenital infection can cause damage to the developing foetus. CMV is the leading infectious cause of newborn disability in high income countries, where an estimated 1 in 200 babies are born with congenital infection. Around 20% of children with congenital CMV will experience significant long-term impacts, most commonly sensorineural hearing loss but also developmental delay, epilepsy and cerebral palsy. Hygiene precautions are the only effective primary prevention strategy, and it is widely recommended that all pregnant women, and those planning a pregnancy, should receive information about these strategies to help reduce the risk of infection. However, most women do not receive counselling about CMV. Here we explore commonly reported health professional capability and motivational barriers to antenatal CMV counselling and the perspectives of pregnant women and people with lived experience of CMV. This review provides an overview on what has been shared by pregnant women and those with lived experience in the literature and dispels some misconceptions about the acceptability and feasibility of CMV hygiene precautions.
PMID: 41508764

28.Reflections on autonomy and participation: 40 years lived experience of cerebral palsy

Rafael Bonfim

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508604

29.Time toxicity and shared decision-making in cerebral palsy

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No authors listed
PMID: 41508364

30.Autonomy in participation of young people with cerebral palsy during the transition to adulthood

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508295

31.Determinants of hospital-based health service use across the lifespan in cerebral palsy: A retrospective observational study

No authors listed

Dev Med Child Neurol. 2026 Jan 8. Online ahead of print.

No abstract available
PMID: 41508283

32.Online Learning for Caregivers of Children and Youth with Neurodevelopmental Disabilities: A Scoping Review

Malina Moskun, Katerina Papadakis, Olivia Passarelli, Mikaela Piccirelli, Jean Pierre Calisto, Leigh Dickson, Georgia Iliopoulos, Natalina Pace, Happy Zabaras, Tatiana Ogourtsova

Phys Occup Ther Pediatr. 2026 Jan 6:1-37. Online ahead of print.

Aims: To explore key components and describe the areas of online learning programs for caregivers of children and youth with neurodevelopmental disabilities (NDDs, e.g. autism, cerebral palsy), examine their impact, and highlight gaps in current knowledge.
Methods: A scoping review, guided by the Arksey and O'Malley framework, was performed in six steps including a comprehensive search across six databases, rigorous study selection, detailed data extraction, synthesis of findings through content analysis, and consultation with five stakeholders (caregivers of children with NDDs).
Results: From 1701 citations, 36 studies were included, over half of which were randomized controlled trials (n = 20, 55.6%). Most programs focused on caregivers of children with autism spectrum disorder, and nearly three-quarters targeted early childhood (0-5 years). Parental knowledge was the most frequently addressed outcome, with 86.1% (n = 31/36) studies reporting significant improvements. Caregiver consultations underscored limited integration of online programs into practice, and emphasized unmet needs related to transition to adulthood, single parent support, and flexible delivery.
Conclusions: Online learning shows strong potential to enhance caregiver outcomes. However, future development should broaden to include diverse NDD populations, adolescence and adulthood transitions, and strategies to embed structured programs into routine clinical practice.
PMID: 41492794

33.Diagnostic Utility of the ATG9A Ratio in AP-4-Associated Hereditary Spastic Paraplegia

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Ann Clin Transl Neurol. 2026 Jan 5. Online ahead of print.

Abstract
Adaptor protein complex 4-associated hereditary spastic paraplegia (AP-4-HSP), a childhood-onset neurogenetic disorder and frequent mimic of cerebral palsy, is caused by biallelic variants in the adaptor protein complex 4 (AP-4) subunit genes (AP4B1 [for SPG47], AP4M1 [for SPG50], AP4E1 [for SPG51], and AP4S1 [for SPG52]). Diagnosis is often confounded by variants of uncertain significance. We evaluated the ATG9A ratio, a measure of ATG9A mislocalization in patient-derived fibroblasts, as a functional assay of AP-4 deficiency. In six of eight individuals with suspected AP-4-HSP, the assay demonstrated loss of AP-4 function, establishing pathogenicity of novel variants. These findings support the ATG9A ratio as a clinically useful diagnostic tool for confirming AP-4-HSP and aiding the classification of novel variants.
PMID: 41491634

34.Expanding Hereditary Spastic Paraplegias Limits: Biallelic SPAST Variants in Cerebral Palsy Mimics

Gregorio A Nolasco, Mònica Roldán, Yalda Jamshidi, Ioannis Georvasilis, Rocío Jadraque Rodríguez, Reza Boostani, Ali Shoeibi, Lluís Armengol, Anna Codina, Ehsan Ghayoor Karimiani, Cristina Hernando-Davalillo, Loreto Martorell, María Luisa Ramírez Almaraz, Jordi Muchart, Carlos Ortez, Andrés Nascimento, Roser Urreizti, Daniel Natera-de Benito, Mercedes Serrano

Ann Clin Transl Neurol. 2026 Jan;13(1):108-121. Epub 2025 Sep 26.

Objective: Hereditary spastic paraplegias (HSP) are rare neurodegenerative disorders marked by spasticity and lower limb weakness. The most common type, SPG4, is usually autosomal dominant and caused by SPAST gene variants, typically presenting as pure HSP. We describe five individuals from three unrelated families who meet the clinical criteria for cerebral palsy and carry biallelic SPAST variants. We aim to increase the clinical and genetic understanding of SPAST-related disorders and explore the underlying abnormal cellular mechanisms.
Methods: We performed comprehensive phenotyping and genetic analysis. In silico and functional studies were conducted using confocal microscopy on fibroblast cultures derived from carriers of the biallelic SPAST variants, a monoallelic SPAST variant, and a healthy control.
Results: Individuals exhibited early-onset complex HSP with a diverse range of encephalopathy severity, spasticity, and neuronoaxonal involvement, occasionally leading to the diagnosis of cerebral palsy. Whole-exome sequencing identified homozygous and compound heterozygous SPAST variants. Functional studies demonstrated reduced spastin and tubulin levels, mitochondrial fragmentation, and abnormal filopodia morphology in patient-derived fibroblasts, supporting the pathogenicity of the variants.
Interpretation: We provide the first evidence of biallelic inheritance in SPAST-related disorders, supported by functional analysis, expanding the clinical spectrum to include moderate-to-severe early-onset encephalopathy. Our findings emphasize the importance of genetic diagnosis in cerebral palsy for prognosis, counseling, and personalized therapy. The identified variants reveal the genetic complexity of SPAST-related disease and suggest a threshold effect of spastin levels in phenotypic variation. Cellular mechanisms such as mitochondrial dynamics and membrane morphology may contribute to pathogenesis and warrant further investigation.
PMID: 41000004

35.An ITPR1 Variant in the IP3-ITPR1 Binding Pocket Associated With a Clinical Phenotype of Athetoid Cerebral Palsy

Thania Ordaz, Jagadish Chandrabose Sundaramurthi, Adam S Arterbery, Anita M Bagley, Michael A Gargano, Jeremy P Bauer, Daniel Danis, Philip Giampietro, Ellen Raney, Lauren Rekerle, Mallory Shingle, Jon R Davids, Peter N Robinson

Am J Med Genet A. 2026 Feb;200(2):459-467. Epub 2025 Sep 18.

Abstract
A de novo, missense variant in ITPR1-inositol 1,4,5-trisphosphate receptor type 1 (ITPR1), p.(Tyr567Cys), was identified by trio whole-genome sequencing in an individual diagnosed with Spinocerebellar ataxia 29 (SCA29) who was affected by cerebral palsy and global developmental delay. The variant affects a residue involved in Inositol 1,4,5-trisphosphate (IP3)-ITPR1 binding. Genotype-Phenotype correlation analysis of the set of missense variants affecting nine residues involved in IP3-ITPR1 binding in the current case and 170 reports of individuals with ITPR1 variants showed a significantly higher frequency of phenotypic features related to neurodevelopmental delay in these variants than in other ITPR1 variants. Our proband was diagnosed with cerebral palsy, as were five other published individuals diagnosed with SCA29. Two of these individuals were siblings who were found to have the variant p.(Arg269Trp), also located in the IP3-ITPR1 binding pocket. These observations suggest that genotype-phenotype correlations exist in the ITPR1 gene and underscore the importance of data sharing and reuse to elucidate the natural history of rare neurodevelopmental diseases.
PMID: 40968496

36.Brain lesion extent, growth, and body composition in children with cerebral palsy

Stina Oftedal, Simona Fiori, Kristie L Bell, Katherine A Benfer, Leanne Sakzewski, Robert S Ware, Peter S W Davies, Roslyn N Boyd

Dev Med Child Neurol. 2026 Feb;68(2):199-210. Epub 2025 Jul 31.

Aim: To investigate the relationship between growth, body composition, and the extent of brain lesion measured using structural magnetic resonance imaging (MRI) in children with cerebral palsy (CP).
Method: This prospective population-based cohort study recorded 359 assessments from 124 children with CP aged 18 months to 13 years (38% female, Gross Motor Function Classification System [GMFCS] levels I = 50, II = 24, III = 17, IV = 12, and V = 21). A neurologist assessed the extent of the brain lesion using a validated semi-quantitative scale (global, basal ganglia/brainstem, hemispheric and corpus callosum scores). Height (HTZ), weight (WTZ), and head circumference (HDZ) z-scores were calculated. The Fat Mass Index (FMI) and Fat-Free Mass Index (FFMI) were determined using a deuterium dilution technique, bioelectrical impedance or dual-energy X-ray absorptiometry, and height. Data were analysed using mixed-effects linear regression.
Results: Greater global (β = -0.04, 95% confidence interval [CI] = -0.07 to -0.02), basal ganglia/brainstem (β = -0.06, 95% CI = -0.11 to -0.02), corpus callosum (β = -0.27, 95% CI = -0.27 to -0.12), and hemispheric (β = -0.08, 95% CI = -0.12 to -0.04) scores were associated with lower HTZ. Greater global (β = -0.03, 95% CI = -0.06 to -0.01) and corpus callosum (β = -0.23, 95% CI = -0.40 to -0.06) scores were associated with lower WTZ. A greater hemispheric score (β = -0.06, 95% CI = -0.119 to -0.001) was associated with lower HDZ. Semi-quantitative MRI scores were not associated with FMI or FFMI.
Interpretation: Greater extent of the brain lesion was significantly associated with lower HDZ, HTZ, and WTZ but not body composition in children with CP aged 18 months to 13 years.
PMID: 40745624

Prevention and Cure

37.AI-Driven Quantitative Metabolomics for Early and Precise HIE Diagnosis: Challenges and Solutions

Ashish Panigrahi, Nihar Ranjan Das, Neha Yadav, Swarupa Panda, Abinashi Sabyasachi Sethy, Santosh Kumar Panda, Nirmal Kumar Mohakud, Vivek Tiwari

ACS Omega. 2025 Nov 24;10(48):57876-57888. eCollection 2025 Dec 9.

Abstract
Adequate cerebral oxygenation is vital for neonatal survival and the establishment of a healthy brain function. A disruption in this critical balance, particularly during the perinatal period, can result in hypoxic-ischemic encephalopathy (HIE)—a severe and potentially fatal form of neonatal brain injury caused by diminished oxygen and blood flow to the brain. HIE is a major contributor to neonatal morbidity and mortality worldwide, with an even greater burden in low-resource settings, where delays in diagnosis and limited access to timely intervention exacerbate long-term neurodevelopmental outcomes. Affected neonates frequently suffer from a spectrum of sequelae, including cerebral palsy, epilepsy, intellectual disability, and other persistent neurological impairments. Currently, therapeutic hypothermia (TH) is the standard-of-care neuroprotective intervention for moderate to severe HIE. However, its efficacy is highly time-dependent and constrained by the critical need for early and accurate diagnosis often within the first 6 h of life. Traditional diagnostic modalities, including clinical assessment, serum protein biomarkers, electroencephalography (EEG), and neuroimaging, frequently lack the sensitivity and specificity required for early risk stratification, thereby limiting their clinical utility during this narrow therapeutic window. In this context, metabolomics-based approaches have emerged as powerful tools to detect subtle early biochemical changes associated with neuronal injury and energy failure. Biomarkers such as lactate, glutamate, succinate, S-100 protein, and CK-BB have shown potential in reflecting metabolic disturbances characteristic of the HIE. Recent advances in nuclear magnetic resonance (NMR) spectroscopy, when integrated with artificial intelligence (AI)-based pattern recognition algorithms, have further enabled the identification of complex metabolic signatures that are both disease-specific and prognostically informative. Despite their promise, the clinical translation of metabolomics-derived biomarkers remains limited by significant preanalytical variability, particularly in sample handling, processing, and storage conditions. Factors such as anticoagulant type, temperature fluctuations, and delays in sample processing can profoundly alter metabolite stability, leading to inconsistent results and reduced reproducibility across cohorts. To address these limitations, this review highlights common pitfalls in blood-based metabolomics workflows and presents a novel, rigorously standardized, multipanel metabolomics strategy for HIE evaluation. By coupling high-resolution NMR spectroscopy with machine learning techniques, we propose the development of a composite "Metabolic Index of Brain Health" that quantitatively captures the extent and severity of hypoxic-ischemic injury. This approach not only enhances diagnostic precision but also enables early risk stratification, paving the way for timely therapeutic interventions.
PMID: 41502645

38.Avoiding routine gastric residual volume measurement in neonatal critical care (the neoGASTRIC trial): study protocol for a multi-centre, unblinded, randomised, controlled trial

Elizabeth Nuthall, Amy Rodriquez, Iza Andrzejewksa, Zainab Aslam, Cheryl Battersby, Catherine Beesley, Christina Cole, Helen Campbell, Kim Dalziel, Jon Dorling, Alan Downs, Peter G Davis, Zoe Daskalopoulou, Amanda Forster, Michaela Graham-Travis, Nigel J Hall, Marie Hubbard, Madeleine Hurd, Pollyanna Hardy, Rod Hunt, Ann Kennedy, Andrew King, Louise Linsell, Brett J Manley, David Murray, Tracy K Mitchell, Heather O'Connor, Shalini Ojha, Charles C Roehr, Oliver Rivero-Arias, Kayleigh Stanbury, Jacqueline Taylor, Lyvonne Tume, Richard Welsh, Joy Wiles, Kerry Woolfall, Lauren Young, Calum Roberts, Chris Gale; neoGASTRIC collaborative group

Trials. 2026 Jan 8. Online ahead of print.

Background: Routine measurement of gastric residual volumes involves regularly aspirating the entire stomach contents to assess the volume and colour of the aspirate to inform feeding. This is an established practice in many United Kingdom and Australian neonatal units for preterm infants receiving gastric tube feeds. The rationale is to assess feed tolerance and to predict and potentially prevent necrotising enterocolitis, a serious gut condition. Routine measurement of gastric residual volumes may also be associated with adverse outcomes and harm, including delayed achievement of full enteral feeds and longer neonatal unit stay. Evidence to support the routine measurement of gastric residuals is poor, and previous small trials have not been generalisable to UK or Australian neonatal care.
Methods: The aim of the neoGASTRIC trial is to test whether avoiding routine measurement of gastric residual volumes in preterm infants reduces the time taken for an infant to reach full enteral feeds without increasing necrotising enterocolitis. neoGASTRIC is an individually randomised controlled trial in neonatal units in the UK and Australia. A target of 7040 infants born before 34 weeks' gestation will be randomly allocated, prior to receiving 24 h of enteral feeds >15 ml/kg/day, on a 1:1 basis to have no routine gastric residual volumes measured, or to have gastric residual volumes measured routinely. Opt-out consent will be used with parent and staff views explored as part of an embedded process evaluation. The primary superiority outcome is time to reach full milk feeds ≥145 ml/kg/day for three consecutive days. Bell's stage 2 or 3 necrotising enterocolitis following blinded adjudication will be the key secondary, non-inferiority safety outcome. Other neonatal core outcomes and health care resource use and costs prior to discharge will be evaluated.
Discussion: neoGASTRIC will address a research priority that affects more than 20,000 preterm infants in the United Kingdom and Australia annually. Even modest improvements in clinical outcomes and resource use could result in large clinical benefits and savings at a population level.
PMID: 41501913

39.MRI, General Movements, and Neurological Examination for Early Cerebral Palsy Diagnosis in Preterm Infants

Shipra Jain, Karen Harpster, Stephanie Merhar, Beth Kline-Fath, Mekibib Altaye, Venkata Sita Priyanka Illapani, Colleen Peyton, Nehal A Parikh

Pediatrics. 2026 Jan 8. Online ahead of print.

Background and objectives: Researchers have not yet collected sufficient prognostic data on the combined use of structural brain MRI (sMRI) with General Movements Assessment (GMA) or Hammersmith Infant Neurological Examination (HINE) in children born preterm for diagnosing cerebral palsy (CP) before 5 months corrected age (CA), particularly for Gross Motor Function Classification System (GMFCS) level I CP. We evaluated the predictive values of sMRI, GMA, and HINE individually and in combination for early CP diagnosis and assessed accuracy across varying GMFCS levels in children born preterm.
Methods: We studied a prospective regional cohort of 395 preterm infants (≤32 weeks' gestation) from 5 NICUs in Greater Cincinnati. The primary outcome was CP diagnosis at 22 to 26 months CA, classified by GMFCS. We calculated sensitivity, specificity, predictive values, and likelihood ratios for CP diagnosis/prediction for an abnormal sMRI (motor tract abnormalities) at 39-44 weeks postmenstrual age and an abnormal GMA (absent fidgety movements) or HINE (score below 56) at 12 to 18 weeks CA.
Results: Of 338 (86%) children with complete follow-up, 39 (11.5%) developed CP (28 GMFCS level I, 11 levels II-V). Combining sMRI and GMA achieved 100% specificity and 22% sensitivity, while sMRI and HINE exhibited 32% sensitivity, 98% specificity. These 2 combinations achieved higher sensitivity (78%-90%) and specificity (98%-100%) for predicting CP levels II to V.
Conclusions: In our preterm cohort, sMRI plus GMA/HINE demonstrated high specificity but low sensitivity in predicting CP, underscoring the need for longer developmental follow-up and more sensitive diagnostic tools for early detection of CP in children born preterm.
PMID: 41500506

40.Cerebral near-infrared spectroscopy monitoring for prevention of death or neurodevelopmental disability in very preterm infants

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Cochrane Database Syst Rev. 2026 Jan 7;1(1):CD011506.

Rationale: Very preterm infants (i.e. born before 32 weeks of gestation) are at risk of cerebral injury and long-term neurodevelopmental impairment. Cerebral near-infrared spectroscopy (NIRS) enables continuous monitoring of cerebral oxygenation to guide clinical management. Interest in NIRS has grown in recent years, highlighting the need for better evidence to support its clinical efficacy in improving brain development and reducing neurological sequelae. This is an update of a Cochrane review first published in 2017.
Objectives: To evaluate the beneficial and harmful effects of cerebral near-infrared spectroscopy (NIRS) monitoring versus no NIRS or blinded NIRS monitoring in very preterm infants.
Search methods: We searched CENTRAL, MEDLINE, Embase, CINAHL, three trial registries, and conference abstracts up to August 2025. We also checked reference lists of included studies and relevant systematic reviews.
Eligibility criteria: We included randomised clinical trials (RCTs) comparing cerebral NIRS monitoring versus no NIRS or blinded NIRS monitoring (where the treating healthcare professionals were unaware of the oxygenation levels) in very preterm infants.
Outcomes: Our critical outcomes included all-cause mortality at longest follow-up, major neurodevelopmental disability in children aged 18 to 24 months (a composite outcome including cerebral palsy, severe neurodevelopmental impairment, blindness, and profound hearing impairment), and major brain injury prior to discharge. Our important outcomes included chronic lung disease at 36 weeks' gestational age, proven necrotising enterocolitis prior to discharge, retinopathy of prematurity (stage ≥ III) prior to discharge, and severe adverse reactions prior to discharge.
Risk of bias: We used Cochrane's original risk of bias tool (RoB 1).
Synthesis methods: We conducted meta-analyses using fixed-effect models to calculate risk ratios (RRs) and 95% confidence intervals (CIs) for all outcomes. We summarised the certainty of the evidence according to GRADE methods.
Included studies: We included five parallel-group RCTs published between 2016 and 2023 that enrolled a total of 2415 infants, with sample sizes ranging from 23 to 1600 infants per trial. The mean gestational age ranged from 26.1 weeks to 33.1 weeks. Four trials were conducted in multiple hospitals in high-income countries across North America, Asia, and Europe. The remaining trial took place in a single hospital in Austria. The comparator was no NIRS in two trials and blinded NIRS in three trials. In all trials, infants in the NIRS group were treated according to brain oxygen saturation values with specific preset treatment regimens, while those in the control group received standard or usual care regardless of NIRS monitoring values. The trials involved infants with varying start times and durations of NIRS monitoring. Only one trial reported major neurodevelopmental disability, and two trials reported retinopathy of prematurity (stage ≥ III). All five trials provided data for the other main outcomes of this review. We identified five ongoing trials.
Synthesis of results: NIRS monitoring compared with no NIRS or blinded NIRS monitoring likely results in little to no difference in all-cause mortality at longest follow-up (RR 0.99, 95% CI 0.82 to 1.18; I^2 = 46%; 5 studies, 2415 participants; moderate-certainty evidence) and major brain injury diagnosed by brain ultrasound prior to discharge (RR 0.99, 95% CI 0.84 to 1.17; I^2 = 13%; 5 studies, 2415 participants; moderate-certainty evidence). The evidence is very uncertain about the effect of NIRS monitoring compared with blinded NIRS monitoring on major neurodevelopmental disability in children aged 18 to 24 months (RR 1.28, 95% CI 0.50 to 3.29; 1 study, 115 participants; very low-certainty evidence). NIRS monitoring compared with no NIRS or blinded NIRS monitoring likely results in little to no difference in chronic lung disease at 36 weeks of gestational age (RR 0.95, 95% CI 0.86 to 1.06; I^2 = 43%; 5 studies, 2415 participants; moderate-certainty evidence), proven necrotising enterocolitis prior to discharge (RR 1.08, 95% CI 0.85 to 1.37; I^2 = 0%; 5 studies, 2415 participants; moderate-certainty evidence), retinopathy of prematurity (stage ≥ 3) prior to discharge (RR 1.15, 95% CI 0.86 to 1.54; I^2 = 0%; 2 studies, 1745 participants; moderate-certainty evidence), and severe adverse reactions prior to discharge (RR 9.41, 95% CI 0.51 to 174.44; I^2 not applicable; 5 studies, 2415 participants; moderate-certainty evidence).
Authors' conclusions: Overall, cerebral NIRS monitoring in very preterm infants likely results in little to no benefit for most measured outcomes. Compared with conventional monitoring, cerebral NIRS monitoring in very preterm infants likely results in little to no difference in all-cause mortality at longest follow-up and in major brain injury diagnosed by brain ultrasound prior to discharge, and we are unsure about its effect on major neurodevelopmental disability in children aged 18 to 24 months. Furthermore, NIRS monitoring likely results in little to no difference in the risk of chronic lung disease at 36 weeks' gestational age, proven necrotising enterocolitis prior to discharge, severe retinopathy of prematurity prior to discharge, and severe adverse reactions prior to discharge. Future randomised trials in very preterm infants should provide continuous NIRS monitoring from birth until cardiorespiratory stability to more accurately assess the potential benefits of the intervention. Further research is needed to understand and quantify performance differences among available NIRS devices and to evaluate their effects on long-term clinical outcomes.
PMID: 41498617

41.Preterm Birth as a Risk Factor for Cerebral Palsy in Children: A Systematic Review and Meta-Analysis

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Neurol Res Int. 2025 Dec 21:2025:3922172. eCollection 2025.

Background: Cerebral palsy (CP) is the most common physical disability in childhood, often resulting from early brain injury. Preterm birth (<37 weeks gestation) is a critical risk factor for CP due to the vulnerability of the immature brain. Despite advances in neonatal care, the risk of CP remains elevated among preterm infants, especially those born very preterm. Existing meta-analyses are limited by outdated data or methodological gaps.
Objective: To provide an updated, comprehensive synthesis of the association between preterm birth and CP risk in children, utilizing recent high-quality observational studies worldwide.
Methods: A systematic review and meta-analysis were conducted following PRISMA 2020 guidelines. We searched PubMed, Web of Science, Scopus, and Google Scholar from inception to May 1, 2024, for observational studies reporting odds ratios (ORs) relating preterm birth and CP in children (<18 years). Studies were screened independently by two reviewers. Methodological quality was assessed via the Newcastle-Ottawa Scale (NOS), including only studies with scores ≥6. A fixed-effects meta-analysis was performed given low heterogeneity ($I^2 = 28.04\%$). Publication bias was evaluated using Egger's test.
Results: Sixteen studies encompassing diverse geographic regions and 30,000+ participants were included. The pooled OR for CP in preterm versus term children was 1.02 (95% CI: 0.72-1.31, $p < 0.0001$), indicating a significantly increased risk associated with preterm birth. No evidence of publication bias was detected (Egger's $p = 0.4783$). The methodological rigor and consistency of findings across varied populations strengthen the evidence for a global association.
Conclusions: While the pooled estimate for the broad preterm birth category was not statistically significant, subgroup analyses confirm that the risk of CP increases significantly with the degree of prematurity. These findings reinforce the need for targeted neurodevelopmental monitoring and early interventions in preterm populations, particularly for those born at lower gestational ages, alongside public health strategies to reduce preterm birth incidence. Future research should stratify risks by degree of prematurity and explore biological modifiers to optimize preventive care.
PMID: 41497195

42.Safety and Feasibility of Autologous Cord Blood Infusion for Cerebral Palsy: A Case Report With Ethical and Translational Considerations

Michael C Fahey, Madison C B Paton, Lauren Haddad, Karen Foreman, Michelle Martin, Iona Novak, Megan Barnett, Mirja Krause-Onwukwe, Annabel Webb, Ngaire Elwood, Megan Finch-Edmondson

J Paediatr Child Health. 2026 Jan 6. Online ahead of print.

No abstract available
PMID: 41493120

43.Maternal hypertensive disorders of pregnancy and childhood neurodevelopmental disorders: A two-sample Mendelian randomization

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Int J Gynaecol Obstet. 2026 Jan 5. Online ahead of print.

Objective: To investigate the association between maternal hypertensive disorders of pregnancy (HDP) and childhood neurodevelopmental disorders (NDD) by Mendelian randomization (MR).
Methods: A two-sample MR analysis was conducted to evaluate the causal effects of HDP, including gestational hypertension (GH), pre-eclampsia superimposed on chronic hypertension, and pre-eclampsia or eclampsia on childhood NDD, such as cerebral palsy (CP), autism spectrum disorder (ASD), and hyperkinetic disorders (HD). The exposure and outcome data were extracted from the FinnGen database. As the genetic and phenotypic data used were from previously collected resources, the analysis of FinnGen data in this study was a retrospective study.
Results: The two-sample MR analysis did not identify a significant causal relationship between maternal HDP and childhood NDD: GH with CP (odds ratio [OR] 1.05, 95% confidence interval [CI] 0.81-1.35), ASD (OR 1.04, 95% CI 0.83 -1.29), and HD (OR 1.02, 95% CI 0.91-1.15); pre-eclampsia superimposed on chronic hypertension with CP (OR 1.03, 95% CI 0.88-1.21), ASD (OR 1.02, 95% CI 0.85-1.23), and HD (OR 1, 95% CI 0.94-1.05); pre-eclampsia or eclampsia with CP (OR 1.07, 95% CI 0.82-1.40), ASD (OR 0.90, 95% CI 0.69-1.18), and HD (OR 0.90, 95% CI 0.80-1.01). The MR -Egger intercept did not detect potential pleiotropy ($P > 0.05$), thereby the results were considered unbiased.
Conclusions: Maternal HDP did not increase the risk of childhood NDD.
PMID: 41489495