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Interventions and Management

1. Combining Nonlinear Mechanical Stimulation via a Chaotic Mathematical Model and Game-Based Exercise for Upper Extremity Rehabilitation in Children With Spastic Hemiparetic Cerebral Palsy: A Pilot Study

Parisa Hosseini, Mohammad Ebrahim Hashemi, Zeinab Ziaee Fard, Donya Zafar Jafarzadeh Noghani, Zahra Ghanbari, Narges Hashemi, Mehran Beiraghi Toosi, Javad Akhondian, Ali Ghanaei Chamanabad, Tahereh Sadeghi, Hamid Reza Kobravi

Biomed Eng Online. 2025 Oct 9;24(1):116

Background: Designing an upper extremity neurorehabilitation protocol for children with unilateral cerebral palsy (UCP) is a significant challenge. In this study, a combined rehabilitation protocol is proposed for restoring upper extremity function in children with unilateral cerebral palsy.

Methods: The proposed protocol combines mechanical stimulation of cutaneous mechanoreceptors on the back of the affected hand with computer game-based training. Drawing on insights into neural self-organization, a chaotic model was identified and utilized to generate the stimulation pattern. The efficacy of the proposed approach was evaluated in four patients.

Results: The results were analyzed across various clinical and signal-processing aspects. The clinical findings are promising, demonstrating intriguing improvement in wrist flexion and extension motion following the interventions. Additionally, nonlinear analyses of EMG dynamics and muscle activation timings suggest that the creation of a new motor program post-intervention is plausible.

Conclusion: Clinical analyses and nonlinear analysis of EMG dynamics supported the emergence of neuroplasticity following the designed rehabilitation protocol.

PMID: [41068800](https://pubmed.ncbi.nlm.nih.gov/41068800/)

2.Sprint-Intensity Arm Interval Training May Improve Cardiorespiratory Fitness and Cardiometabolic Health Among Children With Mobility Disabilities: Case Report

Natalie Dean, Tanvee Sinha, Larsen Bright, Katie M Ellison, Drew Sayer, Raven Young, Drew Davis, James H Rimmer, Byron Lai

Case Reports JMIR Form Res. 2025 Oct 8;9:e64440

Background: There are limited options for aerobic exercise options that improve cardiorespiratory fitness and manage cardiometabolic health that are also age-appropriate and suitable for children with mobility disabilities. Children with disabilities require exercise programs that incorporate adapted movements to meet various functional needs, which offer brief training durations to accommodate busy schedules and use remote training methods at home to bypass logistical transportation barriers.

Objective: The aim of this study is to test the potential effects and safety of a sprint-intensity arm-exercise interval training program, combined with music and telehealth, on cardiorespiratory fitness and cardiometabolic health in a child with cerebral palsy.

Methods: This study was a 12-week exercise intervention from pretrial to posttrial for a single child with cerebral palsy (male, age 17 y). The intervention was conducted at the participant's homes. The participant exercised 3 times per week while following along with YouTube exercise videos. Videos included 4-second maximal sprint bouts followed by periods of rest, which were repeated 30 times during a single exercise session (total of ~2 minutes of maximal exercise). Exercise sessions were supervised by research staff using videoconferencing. Cardiorespiratory fitness was indicated by peak oxygen consumption (pVO₂), which was measured by a portable metabolic cart during a graded exercise test. Cardiometabolic health outcomes included body composition by dual-energy x-ray absorptiometry scan and a cardiometabolic blood profile by a dried blood spot test. Outcomes were descriptively analyzed.

Results: The participant achieved a 33.6% increase in pVO₂ (14.6 to 19.5 mL/kg-1/min-1), a 37.8% improvement in blood triglycerides (82 to 51 mg/dL), and a 15.4% improvement in the total cholesterol to high-density lipoprotein ratio (6.5 to 5.5). Additionally, he had a 5.9% reduction in body weight (171 to 161 lbs) and a 9.6% reduction in total body fat (61.35 to 55.48 lbs) from the arms, legs, and trunk. The participant experienced no adverse events or problems during the intervention. After completing the program, the participant elicited a maximal intensity of exercise using armbands, as demonstrated through pVO₂.

Conclusions: Sprint-intensity interval training that uses the arms may be safe and potentially effective for enhancing cardiorespiratory fitness and cardiometabolic health in children with physical disabilities. Further research is needed to verify the outcomes of this case report.

PMID: [41061149](#)

3.Selective Motor Control Differences in the Lower Extremities and Their Relation to Trunk Control and Balance in Children With Unilateral and Bilateral Spastic Cerebral Palsy

Bayram Sirri, Bülent Elbasan

Exp Brain Res. 2025 Oct 6;243(11):223

Abstract

No abstract available.

PMID: [41051482](#)

4. Experiences of Pediatric Physiotherapists on the Use of Walking Orthoses in Children With Cerebral Palsy: A Quantitative Examination

Halil Hakan Uysal, Cemile Bozdemir Ozel, Sinem Asena Sel, Hande Fidan, Eda Burc, Sabri Erdem, Mintaze Kerem Gunel

Medicine (Baltimore). 2025 Oct 3;104(40):e44835

Abstract

Orthoses play an important therapeutic role in the rehabilitation of children with cerebral palsy (CP). Studies examining the factors that physiotherapists consider when prescribing orthotics are limited in the literature. This study aimed to examine physiotherapists' perspectives and experiences with using walking orthoses in patients with CP. A total of 207 physiotherapists working with children with CP were included in this online cross-sectional study. The questionnaire consisted of examining the knowledge of the physiotherapist about walking orthoses, such as the types of orthoses that are preferred in clinical decision-making, which evaluation methods are used in the decision-making process in orthosis selection, and changes in orthosis usage based on International Classification of Functioning. Less than half of physiotherapists rated their knowledge of orthotics as "good" (n = 102, 49.3%). The most commonly used clinical methods to recommend orthoses are gait pattern, muscle tone, observational gait analysis, and activity targets. Physiotherapists reported a decrease in the severity of the structural disorder in the legs and feet and improvement in participation in daily life and activities after using orthoses. In contrast, social policies and health services pose a major barrier to children's use of orthoses. According to the International Classification of Functioning Framework analysis, mobilization was related to activities of daily living, family and technology use, movement functions, social support and health, and sleep-mood-pain ($P < .001$). The study's findings show that deformity in the lower extremities, mobilization, and activities of daily living in children with CP improved after the use of orthoses. Increasing physiotherapists' knowledge of orthoses may be more advantageous in terms of the effectiveness of the treatment applied.

PMID: [41054166](#)

5. First Assistant Training Level Does Not Impact Postoperative Outcomes and Complications Following Varus Derotational Osteotomy in Patients With Cerebral Palsy

Amith Umesh, Mathangi Sridharan, Gabrielle Noullet, Aura M Elias, Charlotte F Wahle, Michaela L Juels, Nakul Talathi, Rachel M Thompson

J Pediatr Orthop. 2025 Oct 6. Online ahead of print

Introduction: The influence of the first assistant's training level on outcomes of orthopaedic surgery in children with cerebral palsy (CP) remains unknown. As such, this study aims to evaluate the effects of first assistant training level (resident vs. fellow) on perioperative and postoperative outcomes following proximal femoral varus derotational osteotomy (VDRO) in children with CP.

Methods: Pediatric patients (<18 y) with CP who underwent VDRO by a single fellowship-trained pediatric orthopaedic surgeon between 2017 and 2021 were retrospectively reviewed. Patients with a minimum of 2-year follow-up were included. Demographic data, training level of first assistant, and perioperative surgical characteristics (operative time, operating room time, estimated blood loss, length of stay, and peri- and postoperative complications) were recorded. Acute complications (≤ 90 d postoperatively) included medical complications, surgical site infection (SSI), peri-prosthetic fractures, emergency department visits, hospital readmission, and revision surgery. Long-term complications (>90 d postoperatively) included delayed/nonunion, re-subluxation, SSI, symptomatic hardware, and revision surgery. Preoperative and minimum 1-year postoperative migration percentages (MPs) were collected. t tests, χ^2 test, and Fisher exact test were used to detect differences between complication rates and outcomes between resident-assisted (group A) and fellow-assisted (group B) cases.

Results: Sixty-nine patients were included for analysis (group A: 27; group B: 42). Demographic data, medical comorbidities, and surgical complexity were comparable between groups. Perioperative surgical characteristics, acute complications, and long-term complications were equivalent between groups ($P > 0.05$). Minimum 1-year postoperative MPs were lower in group A than group B (1% vs. 7.5%, $P < 0.001$). No patients had MP $\geq 40\%$ at 1-year postoperatively in either group.

Conclusion: Despite the high surgical and medical complexity of osseous hip reconstructions for children with CP, postoperative outcomes are not impacted by the first assistant's training level. While postoperative MPs were slightly lower for patients in the resident-assisted group, these differences were not clinically significant, and 1-year radiographic outcomes were comparable. Resident surgeons should be encouraged to participate in VDRO cases, and families should be reassured that resident participation will not negatively affect outcomes.

PMID: [41051771](#)

6. Impact of Femoral Derotation Osteotomy on Gait in Ambulatory Children With Cerebral Palsy: A Systematic Review and Meta-Analysis

Orsolya Z Gresits, Mátyás Vezér, Marie A Engh, Bence Szabó, Zsolt Molnár, Péter Hegyi, Tamás Terebessy
Braz J Phys Ther. 2025 Oct 3;30(1):101257

Background: Femoral derotation osteotomies (FDRO) are commonly performed in children with cerebral palsy who present with intoeing gait. However, the impact of FDRO on gait function and long-term results remains unclear.

Objective: This study aimed to quantify and qualify gait changes following gait-improving surgeries involving FDRO in ambulatory children with cerebral palsy and no associated hip pathologies, to support individualized decision-making regarding this invasive procedure.

Methods: A systematic search was conducted in May 2023 across six databases. Kinetic, kinematic, temporospatial parameters, and gait scores were extracted pre- and post-FDRO. A random-effects meta-analysis was performed.

Results: Forty-six articles, including 1144 patients, were analyzed. Significant improvements were observed in pelvic rotation (mean change: 6.6°, 95% CI: 2.2 to 11), hip rotation (mean change: 14.4°, 95% CI: 16.7 to -12.1), foot progression angle (mean change: 16.1°, 95% CI: 18.3 to -14), and gait scores (SMD: 0.99, 95% CI: 0.52 to 1.47). The estimated improvement in gait scores corresponded to a 10-point increase in the Gait Deviation Index in the short term and 6.9 points in the long term. No deterioration was found in any assessed parameter. Intoeing gait was corrected in 74% of patients at one year and in 69% at five years postoperatively. The recurrence rate was 13%.

Conclusion: While evidence suggests that femoral derotation osteotomies in ambulatory children with cerebral palsy without hip pathology improve overall gait function, the quality of available data is low. Patient-reported outcomes, including quality of life and satisfaction, are lacking. Definitive surgical indication could not be established; factors to consider include femoral anteversion, hip rotation at gait analysis, patient age, and relevant functional impairments.

PMID: [41045782](#)

7. The Role of Diagnostic Nerve Blocks in Guiding Spasticity Management – Application, Efficacy and Safety: A Scoping Review

Jia Yi Sandra Lau, Deepali Bang, Yeow Leng Tan, Pei Ling Tan, Jing Chen

Am J Phys Med Rehabil. 2025 Sep 10. Online ahead of print

Abstract

Diagnostic nerve blocks (DNBs) are emerging as valuable tools for assessing and guiding spasticity management, yet their clinical application remains variable and underexplored. This scoping review systematically maps the current literature on the use, efficacy, and safety of DNBs across diverse neurological conditions. Following the PRISMA-ScR guidelines, a comprehensive search of PubMed, Embase, and Web of Science was conducted, identifying 15 studies involving 504 patients with spasticity due to stroke, cerebral palsy, spinal cord injury, traumatic brain injury, and other etiologies. DNBs were predominantly applied to the lower limbs, targeting spastic equinovarus foot and stiff knee gait. Reported outcomes included spasticity scales, joint range of motion, gait kinematics, electromyographic changes, and functional mobility tests. Across studies, DNBs consistently supported clinical decision-making including decisions on botulinum toxin dosages, neurolysis and neurectomy. Their use was also associated with improved goal attainment rates. Adverse effects were infrequent and transient. While most studies were of fair quality, limitations included small sample sizes, absence of blinding or powered calculations. Overall, DNBs represent a safe and valuable tool, enhancing diagnostic precision and facilitating personalized, patient-centered spasticity management. Future high-quality studies are needed to establish standardized protocols and strengthen the evidence for their use in clinical practice.

PMID: [41066087](#)

8. "It's Not Just About Football": Experiences of Children With Cerebral Palsy and Their Parents With Frame Football

Fabio Vila-Nova, Sofia Santos, Filipa João, Augusto G Pascoal

Disabil Rehabil. 2025 Oct 6;1–10. Online ahead of print

Purpose: To explore the experiences of children with cerebral palsy (CP) and their parents participating in Frame Football, an adapted sport designed for individuals with walking limitations.

Materials and methods: A qualitative phenomenological approach was employed, involving semi-structured interviews with eight children (aged 9–16 years, GMFCS Levels II–IV) and ten parents. Data was analyzed using the Framework Method, with coding structured around the F-words for Child Development (Function, Family, Fitness, Fun, Friends, and Future).

Results: Interpretive analysis revealed three overarching themes: (1) Redefining Ability through Adapted Play—assistive devices were reimagined as enabling tools, supporting motor function and participation; (2) Belonging through Shared Experience—participants described emotional safety and social connection through shared challenges and teamwork; and (3) Claiming Identity as a Football Player—children embraced athletic roles, building confidence and pride through symbolic and embodied participation in the sport. These experiences spanned multiple F-words domains and highlighted the program's social and emotional significance.

Conclusions: Frame Football offers a meaningful, inclusive context in which children with CP can engage physically, connect socially, and develop positive self-identities. These findings underscore the potential of adapted sports to promote participation, reframe perceptions of ability, and support holistic development within pediatric rehabilitation.

Plain language summary

Adapted sports like Frame Football empower children with cerebral palsy by promoting physical engagement and reframing assistive devices as enabling tools. Social inclusion and emotional safety in team settings foster belonging, confidence, and peer connection. Sport participation builds identity, helping children see themselves as capable athletes, which supports motivation and well-being. Family-centered, community-based programs complement rehabilitation by addressing holistic developmental needs and encouraging sustained participation.

PMID: [41051827](#)

9. Home-Based Telerehabilitation for Pediatric Neurological Motor Disorders: Current Trends and Future Perspectives. A Systematic Review and Meta-Analysis

Valeria Calcaterra, Luca Marin, Luca Guardamagna, Alessandro Gatti, Virginia Rossi, Pamela Patanè, Matteo Vandoni, Gianvincenzo Zuccotti

Digit Health. 2025 Oct 3;11:20552076251357504. eCollection 2025 Jan–Dec

Objective: Telerehabilitation is a rapidly growing area within telehealth, providing clinical rehabilitation services through telecommunication technologies to enhance accessibility, improve care quality, and support patient functionality. Pediatric motor rehabilitation has gained increasing recognition for its vital role in promoting neuromotor development, coordination, and independence in children with congenital or acquired motor disabilities. This systematic review analyzed home-based telerehabilitation interventions for pediatric neurological motor disorders, from the neonatal period onward, aiming to outline current trends and future directions.

Methods: A comprehensive search was conducted across Medline, EBSCO, and Web of Science, covering records up to February 2025. Peer-reviewed articles were included without restrictions on study design. The focus was on pediatric and adolescent populations with neurodevelopmental or neuromuscular disorders undergoing telerehabilitation or remote rehabilitative interventions.

Results: The findings support the potential efficacy of tele-neurorehabilitation in improving motor outcomes, with promising results for children with cerebral palsy and hemiplegia. Interventions were shown to enhance motor function (SMD = 0.48; 95% CI: 0.23 to 0.72), range of motion (SMD = 0.31; 95% CI: 0.11 to 0.51), and walking ability (SMD = 0.25; 95% CI: 0.03 to 0.46), suggesting that remote rehabilitation can be an effective complement or alternative to traditional in-person therapy in pediatric care. Moreover, beyond functional improvements, several studies reported positive effects on children's quality of life, highlighting the broader psychosocial benefits of remote interventions.

Conclusions: These results underscore the holistic value of telerehabilitation, reinforcing its role as a comprehensive and accessible strategy in pediatric rehabilitation services. Multidimensional assessments are essential to capture the broader benefits of telerehabilitation and to guide the development of more holistic, child- and family-centered care models.

PMID: [41050623](#)

10. Effectiveness of Massage Therapy for Constipation in Children With Cerebral Palsy: A Systematic Review and Meta-Analysis

Mengqi Li, Guorui Ding, Ruobing Lan, Yu Li, Shuying Guan, Xiaolei Lu, Yuxing Zhang, Duo Zhao

Complement Ther Med. 2025 Oct 6:103254. Online ahead of print

Background: Constipation affects 75% of children with cerebral palsy (CP). While massage is a safe non-invasive intervention, its clinical adoption remains limited due to insufficient evidence of its efficacy.

Objective: To evaluate the efficacy and safety of massage for CP-related constipation through meta-analysis.

Methods: Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we searched seven databases for randomised controlled trials (RCTs) on pediatric CP-related constipation treated with massage.

Eligible RCTs underwent Cochrane risk-of-bias assessment. Meta-analysis using Stata evaluated the overall efficacy, defecation parameters, and heterogeneity sources.

Results: A total of 11 RCTs involving 728 patients were included. The results of the meta-analysis showed that, compared with traditional therapy alone, massage was more effective in treating constipation in children with CP. This difference was statistically significant ($p < 0.05$), as evaluated by the overall effective rate ($RR = 1.23$; 95% CI = 1.14, 1.33), defecation frequency ($MD = 1.57$; 95% CI = 0.40, 2.75), defecation time ($MD = -3.23$; 95% CI = -3.82, -2.64), and stool form score ($SMD = 0.66$; 95% CI = 0.39, 0.94), confirming the superior efficacy of massage over conventional therapy. However, both interventions showed comparable effects on defecation difficulty ($p > 0.05$). The baseline patient characteristics, duration and techniques of the massage, and efficacy of the control group intervention may be the sources of heterogeneity.

Conclusion: Massage therapy improves constipation symptoms in children with CP. These results require validation through larger, high-quality RCTs given the sample size limitations of the current study.

PMID: [41061999](#)

11. Statistical Shape and Fibre Orientation Model for Muscle Architecture Characterisation of the Medial Gastrocnemius

Salim Bin Ghouth, Thor Besier, Geoffrey Handsfield

Ann Biomed Eng. 2025 Oct 9. Online ahead of print

Purpose: Cerebral palsy (CP) is a heterogeneous, neurodevelopmental disorder arising from a static brain lesion and leading to progressive muscle degeneration. Quantitative understanding of 3D muscle morphology and fibre architecture effects of CP are lacking. Here, we present a novel imaging and computational method to investigate morphology and 3D fibre orientations of skeletal muscles in adolescents with CP.

Methods: Principal component analysis was performed on data derived from conventional MRI and diffusion tensor MRI; principal components (PCs) described dominant variations in each cohort. We applied this method to the medial gastrocnemius muscles of seven young people with CP and eight typically developing controls to quantitatively assess deviations in muscle structure associated with CP.

Results: Morphology and architecture models in each cohort had similar variance of dominant features, with size being the predominant mode of variation in both cohorts. The first three PCs accounted for a cumulative variance of CP and TD cohort of 96 and 97%, and 95 and 97% for shape models and shape and fibre orientation models, respectively. Size differences were greatest in the proximal and distal regions, rather than middle, of the muscle. Models revealed localised variation in 3D fibre orientations between the two cohorts in medial-distal region of the muscle. Local variations were observed in the medial-distal regions of the mean muscle of about 10° in the TD model compared to the CP model. PCs of architecture models indicated that greater localised angular differences in the 3D fibre orientations were associated with larger-than-average muscles.

Conclusion: This work offers insights into both muscle morphology and architecture of the medial gastrocnemius in individuals with CP, including variations of overall size and localised muscle fibre orientations. The quantitative descriptions of muscle architecture we present here may contribute to greater understanding of muscle function and dysfunction and may motivate imaging-informed perspectives on therapeutic interventions for CP.

PMID: [41068536](#)

12. Impact of Computerised Visual-Motor Integration and Visual Perception Training Games on Handwriting and Visual Skills in Children With Spastic Cerebral Palsy: Study Protocol for a Randomised Controlled Trial

Aida Kazemnazhand Asl, Hamid Dalvand, Hooshang Dadgar, Masoud Khorrami-Nejad, Kheirollah Rahsepar Fard

BMJ Open. 2025 Oct 7;15(10):e101304

Introduction: Visual perception and visual-motor integration skills are key predictors of handwriting. Children with cerebral palsy often experience difficulties in these areas, which can negatively affect handwriting. Interventions targeting these skills may improve handwriting outcomes in this population.

Methods and analysis: This single-blind (data analyst blinded), three-arm randomised controlled trial will include 30 children with spastic cerebral palsy. Participants will be randomly allocated to one of three groups: (1) a computerised visual-motor integration training group, (2) a computerised visual perception training group or (3) a control group. Randomisation will be performed using a stratified permuted block design based on cerebral palsy subtype (hemiplegia, diplegia and quadriplegia). Each intervention group will receive 20 individual sessions (two times per week for 10 weeks) using validated computerised games. The primary outcome is handwriting performance, assessed by the Persian Handwriting Assessment Tool. Secondary outcomes include visual-motor integration, assessed by the Beery-Buktenica Developmental Test of Visual-Motor Integration, and visual perception, assessed by the Test of Visual-Perceptual Skills-Revised.

Ethics and dissemination: This study was approved by the Ethics Committee of Tehran University of Medical Sciences. Written informed consent will be obtained from parents. Participation is voluntary, free and confidential. Control group participants may receive the intervention after the trial. Results will be published in peer-reviewed journals and shared with relevant stakeholders.

PMID: [41062133](#)

13. Effectiveness of Upper Extremity Exoskeletons in Children With Cerebral Palsy Within International Classification of Functioning, Disability and Health Domains: A Systematic Review

Ghodsiyeh Joveini, Sahar Boozari, Armin Zareiyan, Mahnaz Hejazi-Shirmard, Nick Stergiou

Child Care Health Dev. 2025 Nov;51(6):e70163

Background: Upper extremity impairments in children with cerebral palsy (CP) often lead to activity limitation and participation restrictions. Recent advances in exoskeleton technology offer promising potential for enhancing rehabilitation outcomes. This systematic review investigates the impact of upper extremity exoskeletons on children with CP using the International Classification of Functioning, Disability and Health (ICF) framework.

Methods: Following PRISMA guidelines, five electronic databases were searched without time limitations (PROSPERO ID: CRD42021282377). Studies included randomized and non-randomized trials, focusing on upper extremity exoskeleton interventions for children with CP and published in English. Data were screened and extracted by two independent reviewers. The risk of bias was evaluated using the Revised Cochrane Risk of Bias Tool and the Risk of Bias in Non-Randomized Studies of Interventions for randomized and non-randomized studies, respectively.

Results: A review of 22 studies involving 274 participants assessed the effectiveness of upper extremity exoskeletons on children with CP across different ICF domains. The studies employed various designs, including randomized controlled trials, cohort studies and case series, with a primary emphasis on body functions and structures.

Conclusion: While advancements in body function and structure are noteworthy, they do not inherently lead to improved activity and participation, highlighting the importance of conducting further research to evaluate the effectiveness of exoskeletons, particularly in enhancing participation outcomes among children with CP.

PMID: [41054899](#)

14.A Pilot Study to Evaluate the Efficacy of Robotic Biofeedback-Based Upper Limb Rehabilitation in Children With Hemiplegic Cerebral Palsy

J N Goswami, Vishal Sondhi, S K Patnaik, Pawan Dhull, Rohit Tandon, Manu Bamal, Ankita Gambhirrao

Med J Armed Forces India. 2025 Sep–Oct;81(5):542–550

Background: Robotic biofeedback-based Cerebral Palsy (CP) rehabilitation is a novel rehabilitative modality. This single (assessor) blind randomized controlled multicentric pilot trial compared the efficacy of robotic biofeedback-based therapy as an add-on therapy along with conventional physiotherapy versus conventional physiotherapy alone in children with hemiplegic CP between 5–18 years.

Methods: The trial was conducted in two centres for 2.5 years. Hemiplegic CP children with Gross Motor Function Classification System (GMFCS) scores: I–III children were enrolled. Enrolled children's baseline paretic limb Hand-Grip Strengths and Quality of Upper Extremity Skills Test (QUEST) scores were recorded. Children in Intervention Arm received robotic biofeedback-based therapy and conventional physiotherapy. In Control Arm, only conventional physiotherapy was administered. Differential changes in mean hand-grip strengths after 12 months were compared between the two groups (primary outcome). Secondary outcomes included changes in grip strength at 15 months and QUEST scores at 12 and 15 months.

Results: 60 children were enrolled (30 in each Arm). There were 5 dropouts (2 from Intervention Arm). The difference of mean hand-grip strengths between the two groups at 12 months was (–) 0.05, which was insignificant ($p = 0.40$). The difference in secondary outcomes between the two groups was not significant either. No adverse effects were noted.

Conclusion: Add-on robotic biofeedback-based upper limb rehabilitation does not improve hand-grip strength (at 12 and 15 months) and QUEST scores (at 12 and 15 months) of hemiplegic CP children undergoing conventional physiotherapy. The study demonstrated the feasibility, acceptability and lack of adverse effects of this hybrid modality.

PMID: [41048641](#)

15.Challenges in the Management of Decreased Fetal Movement in Fetomaternal Hemorrhage With Cerebral Palsy: A Nationwide Registry Study

Yoshimitsu Wada, Hironori Takahashi, Manabu Ogozawa, Kenji Horie, Hirotada Suzuki, Rie Usui, Seung Chik Jwa, Akihide Ohkuchi, Hiroyuki Fujiwara

J Obstet Gynaecol Res. 2025 Oct;51(10):e70106

Aim: To describe how decreased fetal movement (DFM) was managed in patients with fetomaternal hemorrhage (FMH) and to evaluate the diagnostic limitations of this condition in real-world settings.

Methods: This retrospective cohort study included individuals who developed FMH with cerebral palsy from the Japanese nationwide cerebral palsy registry between 2009 and 2022. We investigated whether patients experienced DFM or were prenatally diagnosed with FMH. Furthermore, we assessed how DFM was managed.

Results: This study included 57 patients who developed FMH with cerebral palsy, and none were prenatally diagnosed with FMH. DFM was present in 43/57 (75.4%) patients. A sinusoidal pattern was observed in 29/57 (50.9%) patients, and elevated middle cerebral artery peak systolic velocity (MCA-PSV) was detected in 6/10 (60.0%) patients who underwent this test. Of the 43 patients with DFM, 42 (97.7%) sought medical care for this symptom; however, only 12 (27.9%) underwent examinations on the same day as the onset of DFM, and 9 (20.9%) were admitted on that same day. Furthermore, 6/43 (14.0%) were instructed to stay home after telephone consultation or medical examination for this symptom. In five of the 43 patients (11.6%) who experienced DFM, the initial non-stress test was reactive. However, all these patients eventually developed either a non-reactive or non-reassuring fetal status.

Conclusions: DFM was prevalent among pregnancies complicated by FMH; however, it was often inadequately managed, resulting in diagnostic delays. Furthermore, fetal heart rate monitoring and MCA-PSV evaluations had diagnostic limitations. To facilitate early treatment, clinicians need to promptly assess preceding DFM while recognizing the limitations of existing tests.

PMID: [41074620](#)

16. Heatstroke, Dehydration, and Missed Voices: The Hidden Pediatric Crisis in Children With Cerebral Palsy Amid Pakistan's Climate Emergency

Muhammad Umar, Rayyan Nabi, Aftab Ahmed Dero, Muhammad Talha, Syed Moinnuddin, Yassar Sattar

Pediatr Res. 2025 Oct 8. Online ahead of print

Abstract

No abstract available.

PMID: [41062818](#)

17. Cognitive Functioning in Children and Adolescents With Cerebral Palsy Living in Sweden

Ann I Alriksson-Schmidt, Barbro Lindquist, Maja J Knudsen, Pia Ödman, Åsa Korsfeldt, Kristine Stadskleiv

Child Neuropsychol. 2025 Oct 8:1–29. Online ahead of print

Abstract

Cognition in children with cerebral palsy (CP) is often affected. How cognition differs by functional level and subtype is not clear, and the effects of adapted response modes need investigation. In this study, the aims were to investigate how many psychologists reported that interpreters and/or augmentative and alternative communication (AAC) were used, how many assessments were adapted, if there were clinical characteristics associated with whom had been assessed, and to delineate scores from the Wechsler scales with CP by sex, subtype, gross motor function (GMFCS), manual abilities (MACS), and communication level (CFCS). This was a Swedish register study that included two cohorts of children with CP. Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III/IV) and Wechsler Intelligence Scale for Children (WISC-IV/V) served as dependent variables. Descriptive statistics, logistic regression, and multiple regressions were performed. Interpreters and AAC were used in 5% and 13% of the assessments, respectively. Adapted assessments were associated with lower verbal intelligence (VIQ), performance intelligence (PIQ), and full-scale intelligence (FSIQ) mean scores. Assessment practices were associated with GMFCS, MACS, and subtype. Age was negatively associated with PIQ and FSIQ. Children with spastic unilateral CP scored higher than children with ataxic CP on VIQ, PIQ, and FSIQ. Mean scores were significantly different across MACS levels. Children with less affected gross motor, manual, and communication functioning and those with spastic CP were more likely to be assessed. Irrespective of subtype, GMFCS, MACS, and CFCS levels, the ranges of scores were wide, highlighting the great heterogeneity of cognition in this population.

PMID: [41060266](#)

18. Early Detection of Cerebral Palsy Among a High-Risk Cohort in Bangladesh

Tasneem Karim, Anna Te Velde, Annabel Webb, Catherine Morgan, Nadia Badawi, Iona Novak, Saifuddin Ahmed, Shafiul Islam, Iskander Hossain, Nazrul Islam, Mohammad Muhit, Gulam Khandaker

BMJ Paediatr Open. 2025 Oct 5;9(1):e003921

Objective: To evaluate the predictive validity of best practice early detection tools for cerebral palsy (CP) in a high-risk cohort.

Study design: Prospective longitudinal cohort study.

Setting: Neonatal intensive care unit of a regional tertiary hospital in Bangladesh.

Participants: Neonates with risk factors for CP admitted to Mymensingh Medical College Hospital Neonatal Intensive Care Unit between November 2019 and March 2020.

Outcome measures: General Movements Assessment (GMA) at writhing and fidgety periods; Hammersmith Infant Neurological Examination (HINE) and Peabody Developmental Motor Scales Second Edition (PDMS-2) conducted in person at 3, 12 and 24 months. The Developmental Assessment of Young Children (DAYC-2), Ages and Stages Questionnaire (ASQ-3) and Developmental Milestones Chart (DMC) were administered remotely at 6, 9, 12, 18 and 24 months. Due to the impact of COVID-19, a proportion of the cohort was not able to have GMA fidgety videos completed and the first HINE assessment was delayed.

Results: A total of 227 infants were enrolled. Of the surviving infants assessed at 24 months, 36 (29%) had a confirmed diagnosis of CP. The most accurate combination of tools for early detection was GMA and HINE at 3 months (sensitivity 0.91; specificity 1.00). The PDMS-2 Total Motor Quotient, with an optimised cut-off of 59, showed high accuracy at 24 months (sensitivity 0.94; specificity 0.99). Among the tools administered remotely, the DAYC-2 PD, DMC (Gross and Fine Motor domains) and ASQ-3 (Gross and Fine Motor domains) demonstrated strong predictive validity—both individually and in combination—at 9, 12, 18 and 24 months, supporting their use as practical alternatives when in-person assessments are not feasible.

Conclusions: Despite pandemic-related disruptions, an accurate diagnosis was possible as early as 3 months of age using the best practice tools. Our findings support the practicability of scalable early detection models integrating in-person and remote assessments to improve access to timely diagnosis.

PMID: [41052810](#)

19. Prevalence and Co-Occurring Developmental, Neurological, and Mental Health Conditions of Cerebral Palsy Among Children in the United States: 2016–2021

Lin H Tian, Sarah C Tinker, Lauren A Russell, Laurel Joncas-Schronce, Melissa L Danielson, Asha Z Ivey-Stephenson, April D Summers, Marshelyn Yeargin-Allsopp, Matthew J Maenner

Matern Child Health J. 2025 Oct 6. Online ahead of print

Introduction: Monitoring cerebral palsy (CP) prevalence and co-occurring conditions is crucial for planning lifelong support, but recent national estimates are somewhat limited.

Methods: We analyzed data on U.S. children aged 2–17 years from the 2016–2021 National Survey of Children's Health, conducted annually using a cross-sectional design, to calculate nationally representative prevalence estimates of ever-diagnosed CP, overall and by selected demographic and perinatal characteristics. Three-year estimates were compared to evaluate changes over time. Co-occurring conditions were assessed among children aged 3–17 years with a current CP diagnosis. We estimated prevalence ratios (PR) to quantify differences between groups.

Results: The overall prevalence of CP was 3.1 per 1,000 children, with a higher prevalence among boys (3.6/1,000) than girls (2.5/1,000) and children born with low and very low birthweight (46.6 and 7.1/1,000, respectively) and premature (12.7/1,000); differences by race/ethnicity did not reach statistical significance (non-Hispanic [NH] White: 2.9, NH Black: 4.2, and NH other: 4.5/1,000). There were no clear changes in CP prevalence over time, but caregiver-rated severe CP increased from 16.8% (2016–2018) to 30.3% (2019–2021). Most children with CP had at least one co-occurring condition, about four times more prevalent than in children without CP, with the largest differences for intellectual disability (PR = 43) and epilepsy or seizure disorder (PR = 69).

Discussion: There is a significantly higher prevalence of co-occurring developmental, neurological, and mental health conditions among children with CP compared to those without, highlighting the diverse services and resources that may be needed to optimally support this population as they transition into adulthood.

PMID: [41051646](#)

20. Hereditary Spastic Paraplegia Associated With the AP4S1 Gene: A Case Series Highlighting Diagnostic Pitfalls and Phenotypic Variability

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Mol Syndromol. 2025 Oct;16(5):489–497

Abstract

Introduction: Complex hereditary spastic paraplegias (HSPs) are defined by progressive spasticity with diverse neurological manifestations, complicating the diagnostic process. Pathogenic variants in genes encoding subunits of the adaptor protein complex-4 (AP4), including the AP4S1 gene, have been implicated in a subset of HSPs.

Case presentation: We report three siblings with complex HSP harboring pathogenic AP4S1 gene variants, focusing on the clinical characteristics and the diagnostic challenges and pitfalls. The patients exhibited common clinical features such as progressive spasticity, distinctive craniofacial features, and neurodevelopmental delays. Neuroimaging findings included agenesis of the corpus callosum and ventricular enlargement in two siblings, whereas one sibling demonstrated normal brain imaging. Initially, these cases were misdiagnosed as cerebral palsy, leading to unwarranted surgical interventions for tethered cord syndrome. Copy number variation analysis identified homozygous deletions in the AP4S1 gene.

Conclusion: In patients with progressive spasticity, seizures, distinctive craniofacial features, and neuroimaging anomalies, AP4S1-related HSP should be considered in the differential diagnosis. Enhanced awareness and further studies are vital for improving diagnostic precision and management of these intricate neurogenetic disorders.

PMID: [41059447](#)

21. An Updated Cerebral Palsy Description: Reflections on Semantics, Genetics, and the Usefulness of a Plain Language Version

Anina Ritterband-Rosenbaum, Line Zachø Greve, Pernille Ulrik Kaster, Patricia de Liphay Behrend

Dev Med Child Neurol. 2025 Oct 4. Online ahead of print

Abstract

No abstract available.

PMID: [41045505](#)

Prevention and Cure

22. Intrauterine Inflammation and Short- to Long-Term Neurodevelopment in Preterm Infants: An Overview

Fanny Salmon, Mathilde Letouzey, Gilles Kayem

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Abstract

The aim of this review is to gather the most recent data on the association between intrauterine inflammation and neurodevelopmental disorders in preterm infants. Two major methodological challenges will be emphasized: first, the heterogeneity of definitions of intrauterine inflammation; and second, the heterogeneity of study populations, in which the causes of preterm birth (spontaneous labor, preterm premature rupture of membranes, maternal hypertensive disorders, etc.) are not always distinguished. These elements introduce a risk of confounding bias and partly explain the divergence between studies. In the short term, intrauterine inflammation is associated with an increased risk of early-onset sepsis and necrotizing enterocolitis. However, the effects on respiratory and neurological outcomes are less clear, and whether an association exists remains controversial. In the longer term, in populations homogeneous with respect to the cause of prematurity, clinical chorioamnionitis has been associated with an increased risk of cerebral palsy at 2 years, a risk further amplified when combined with histological chorioamnionitis. However, this risk of cerebral palsy does not appear to persist beyond 5 years, and no major association has been reported on cognitive, sensory, coordination, or behavioral functions. Regarding isolated histological chorioamnionitis, most studies conducted on homogeneous populations do not report an association with neurodevelopmental disorders. Nevertheless, some suggest that severe inflammation, particularly in the presence of a fetal inflammatory response, may increase the risk of neurodevelopmental impairment. In conclusion, while intrauterine inflammation is associated with increased neonatal morbidity, its long-term impact on neurodevelopment appears limited and dependent on the severity of the inflammation. These findings highlight the importance of conducting longitudinal studies on homogeneous populations to refine our understanding of developmental trajectories in preterm infants.

PMID: [41072620](#)

23.Implementation of Magnesium Sulfate Into Clinical Practice to Reduce Cerebral Palsy and Neurodisabilities in Children Born Preterm

Clément Chollat, Jean-Baptiste Müller, Alexandra Chadie, Marie Brasseur-Daudruy, Eric Verspyck, Stéphane Marret

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Abstract

The up-dated literature, notably the 2024 Cochrane review, and meta-analysis with individual data, as well as the identified socio-economic benefits, confirms that the administration of magnesium sulfate is recommended in women at risk of imminent preterm delivery before 32 weeks of gestation. In preterm infants, this intervention significantly reduces the risk of neonatal intracranial haemorrhage (moderate level of evidence), which is associated with an increased risk of subsequent neurodisabilities, as well as a very significant reduction in the risk of subsequent cerebral palsy in children (strong level of evidence). No effect on fetal, neonatal or infant mortality rates was observed. Given the still high rates of CP in the subgroup of children born between 30 and 32 or even 32–34 SA, and the absence of severe adverse events in both mother and child, it could be proposed to administer MgSO₄ up to 34 SA (expert opinion). Magnesium sulfate is currently the only pharmacological molecule with a proven neuroprotective effect in preterm infants. It represents one of the means available to us to modulate the neurodevelopmental trajectory of the child, in particular the development of neuromotor skills. Optimization of administration methods is now a major challenge, with the aim of achieving an antenatal administration rate of over 90% in eligible patients. Further studies are needed to determine the optimal dosage, the timing of administration, the appropriateness and duration of the maintenance dose, the route of administration and, finally, the long-term outcome of children exposed to MgSO₄ in the antenatal period.

PMID: [41072617](#)

