Cerebral palsy research news

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Interventions and Management

1.Efficacy of repetitive peripheral magnetic stimulation in managing spasticity of the triceps surae muscle in children with cerebral palsy: a retrospective analysis of influencing factors

Xin Zhao, Yujuan Wang, Li Gao, Yao Shi, Jing Yang, Guojun Yun

BMC Pediatr. 2025 Nov 6;25(1):912

Background: Cerebral palsy (CP) is a neurodevelopmental disorder characterized by spasticity, which significantly impairs motor function. Traditional treatments offer limited relief and carry risks. Repetitive peripheral magnetic stimulation (rPMS) presents a promising non-invasive alternative. This study aimed to evaluate the efficacy of rPMS in managing triceps surae spasticity in children with CP and to identify factors influencing its effectiveness.
Methods: A retrospective cohort study was conducted with 271 children aged 6–12 years with CP (GMFCS levels I–II). Participants were assigned to conventional treatment (n = 131) or rPMS (n = 140) groups. Outcomes were assessed using the Modified Tardieu Scale (MTS), Berg balance scale (BSS), Edinburgh Visual Gait Score (EVGS) and integrated electromyography (IEMG). Treatment efficacy was defined based on improvements in the Gross Motor Function Measure-88 (GMFM-88). Logistic regression identified factors influencing rPMS efficacy.
Results: The rPMS group showed significantly greater improvements in spasticity (reduced MTS and EVGS scores), balance (increased BBS scores), and muscle coordination (IEMG changes) compared to the conventional group ($P < 0.05$). The overall effectiveness rate was 85.00% for rPMS vs. 74.81% for conventional treatment ($P = 0.036$). Multivariate analysis identified the type of CP (diplegia vs. hemiplegia) and patient compliance as significant factors influencing the efficacy of rPMS.
Conclusion: Our results indicate that rPMS significantly controls spasticity and improves lower limb motor function. Importantly, we identified that certain types of CP and patient compliance are significant predictors of treatment efficacy. These findings suggest that optimizing rPMS protocols based on patient-specific characteristics can enhance therapeutic outcomes.
PMID: 41194071

2.Surgical Reconstruction of the Upper Extremity in Patients With Cerebral Palsy: Indication, Techniques, and Rehabilitation Considerations

Elaine Zi Fan Soh, Hyun Sik Gong

Ann Rehabil Med. 2025 Oct;49(5):279–289. Epub 2025 Oct 31

Abstract
Management of upper limb deformities in patients with cerebral palsy is crucial, given its impact on activities of daily living, social interaction, and self-esteem. While medical management and rehabilitative therapy—including the use of assistive devices—remain the foundation of treatment, significant advancements have been made in surgical reconstruction techniques aimed at enhancing functional outcomes. Despite this, many eligible patients may miss the opportunity for surgical intervention due to limited awareness of appropriate indications, candidate selection criteria, and the availability of specialized expertise. This article provides an overview intended to guide pediatric rehabilitation physicians in recognizing common upper limb presentations in cerebral palsy, conducting appropriate assessments, selecting candidates, and understanding available surgical reconstructive options.
PMID: 41177150

3.Fracture prediction by bone trait dis-integration using DXA among a clinical cohort of adults with cerebral palsy

Daniel G Whitney, Michelle S Caird, Edward A Hurvitz, Karl J Jepsen

J Clin Densitom. 2025 Sep 8;29(1):101625. Online ahead of print

Introduction/background: Multi-trait vs. single trait approaches, such as dis-integration patterns of key size-mass traits, may better capture the heterogeneity of bone strength profiles for skeletally complex populations like adults with cerebral palsy (CP). The objective was to assess if dis-integration of dual-energy x-ray absorptiometry (DXA)-derived bone traits predict fracture incidence among adults with CP.
Methodology: This was a retrospective cohort study including n=75 adults with CP with a hip DXA from 01/01/2012-03/05/2021 from a single Medical Center; individuals were followed through 9/12/2023 for fracture incidence. Logistic regression estimated the odds ratio (OR) of fracture by the exposure, an interaction between (1) the residual of the BMC-area linear regression and (2) bone area, after adjusting for confounders. Discrimination (c-statistic) was assessed to compare whether the primary exposure or BMD better predicted incident fracture.
Results: Femoral neck BMC-area residual was associated fracture incidence (n=19 fractures) but was conditional on bone area (P-for-interaction, 0.026-0.067). A lower residual was associated with increased OR for smaller areas (e.g., at 10th percentile of area, OR = 1.18; 95 %CI = 0.96-1.45), but a lower OR for larger areas (e.g., at 90th percentile of area, OR = 0.88; 95 %CI = 0.77-1.02). The primary exposure had higher discrimination of incident fracture compared to BMD across all unadjusted and adjusted models (c-statistic range 0.69-0.84 vs. 0.49-0.79, respectively).
Conclusions: Dis-integration of key size-mass bone traits was associated with incident fracture and was a stronger predictor of fracture compared to BMD in this clinical cohort of adults with CP.
PMID: 41202485

4.The impact of comprehensive correction and trunk stability of posterior thoracic to pelvic fixation in nonambulant neuromuscular scoliosis as assessed by CPCHILD analysis

Shimei Tanida

J Pediatr Orthop B. 2025 Nov 6. Online ahead of print

Abstract
We evaluated the imaging and clinical outcomes of posterior thoracic-pelvic corrective fixation (TP-PCF) for nonambulant neuromuscular scoliosis (NA-NMS), including the Caregiver Priorities and Child Health Index of Life with the Japanese version of the Disabilities Questionnaire (J-CPCHILD), and analyzed the J-CPCHILD and preoperative and postoperative radiographic parameters to determine whether sagittal and coronal alignment correlate with preoperative and postoperative quality of life (QoL) in NMS, respectively. Twenty-five patients (nine males and 16 females) with a mean age of 14.3 ± 2.0 years, who had TP-PCF and were followed up for >2 years postoperatively, were included. Sitting radiographs and the J-CPCHILD were evaluated preoperatively, at 1 year postoperatively, and at the final visit. Preoperative major curve and pelvic obliquity (PO) were 102.4 ± 22.2 ° and 21.5 ± 9.9 °, which significantly improved to 51.4 ± 18.8 ° and 10.9 ± 7.6 °, respectively, at the final visit. At the final visit, lumbar lordosis and sacral slope showed a significant increase of 46.6 ± 18.5 ° and 30.2 ± 17.5 ° compared with preoperative values of 25.8 ± 33.2 ° and 24.4 ± 31.0 °, respectively. Sagittal vertical axis showed a significant decrease of 2.2 ± 35.3 mm at the final visit compared with 37.1 ± 36.5 mm preoperatively. However, iliac screw (IS)-related implant failure was observed in four (16%) patients. Significant improvement from 37.1 ± 20.8 to 51.2 ± 25.2 points and from 49.6 ± 12.6 to 59.1 ± 14.9 points was observed in the positioning domain (P = 0.047) and total score (P = 0.032) of the J-CPCHILD, respectively, at 1 year postoperatively compared with preoperatively. However, no correlations were identified between the respective domains of the J-CPCHILD and the magnitude of the major curves, PO, or sagittal plane vertical axis, either preoperatively or postoperatively. According to caregivers, improvement in comprehensive trunk stability with better global balance, similar to that of the ambulant patient, contributed to overall QoL after TP-PCF for NA-NMS. However, IS-related implant failure occurred in approximately 16% of the patients.
PMID: 41198070

5.Dynamic Balance Perception and Sensory Integration in Children with Non-Progressive Brain Injury: The Role of Visual Input and Foot Pressure

Yuntae Hwang, Jiyong Kim, Jiyoung Lee, Chunghwi Yi

NeuroRehabilitation. 2025 Nov 6. Online ahead of print

Background: Postural control in children with non-progressive brain injury (NPBI), such as cerebral palsy, is often impaired due to deficits in vestibular and somatosensory integration. While static balance has been studied, few have assessed how these children perceive anterior-posterior dynamic tilt and how this sensory dependence differs from children with typically developing (TD).
Objective: This study aimed to examine how visual input and foot pressure influence anterior-posterior dynamic balance perception in children with NPBI, aiming to predict their consequences for postural control strategies and to characterize their sensory-motor integration compared to children with TD.
Methods: Thirteen children with NPBI and fifteen children with TD performed ascending and descending tilt tasks on an anterior-posterior dynamic tilt table under visual input (VI) and visual blocking (VB) conditions. Stopping angles and perception errors were recorded. Static balance was assessed using foot pressure distribution and vestibular sway on a force plate. Wilcoxon signed-rank and Mann-Whitney U tests compared conditions, and Spearman's rank correlation examined associations among variables.
Results: Children with NPBI showed significant differences between VI and VB across dynamic tasks ($p < 0.05$), while children with TD differed only in ascending trials. Vestibular sway was unaffected by vision. Between-group comparisons revealed greater errors during descending tasks and reduced heel pressure in children with NPBI. Higher forefoot pressure correlated with increased sway, and lower heel pressure with greater postural displacement.
Conclusion: Children with NPBI rely more on visual input for anterior-posterior dynamic balance, especially during posterior tilt. The findings support interventions promoting sensory reweighting and heel contact to improve stability.
PMID: 41197151

6.Action observation therapy effects on motor function and balance in cerebral palsy: an fNIRS-based randomized trial

Melike Özipek, Mevhibe Saricaoglu, Lütfü Hanoğlu, Fatma Mutluay

Trials. 2025 Nov 3;26(1):465

Abstract
Cerebral palsy (CP) is an umbrella term for movement, motor, and posture disorders that occur in the developing brain from any non-progressive cause. Action observation therapy (AOT) is a method used in the treatment of motor disorders. Here, the manuscript presents the study protocol for the effect of AOT on balance using functional near-infrared spectroscopy (fNIRS). This study protocol aims to comprehensively evaluate the impact of AOT in patients with CP regarding brain activation and behavioral and motor symptoms. This is a single-center randomized controlled trial for patients with CP. Patients determined eligible according to the study criteria will be randomized into two treatment groups: the action observation therapy group and the control group. Each group will include 12 patients, and the age range is 5–15. The patients will be treated for 15 sessions for three consecutive weeks. In this study, AOT will be applied to improve balance. The following tests will be applied to evaluate the patients' motor function and balance skills before rehabilitation. Gross Motor Function Measure-88 (GMFM-88)-D and E parts, Lower Extremity Selective Control Evaluation Scale (SCALE), The Trunk Impairment Scale (TIS), Pediatric Balance Scale, Nintendo Wii-Fit Balance Score, Timed Up and Go Test (TUG), and Pediatric Data Collection Tool (PODCI) will be applied. Brain regional blood flow changes during static and dynamic balance will be evaluated with fNIRS. All evaluations will be performed before treatment and repeated after treatment.
PMID: 41184905

7.Coordination index – A method for the assessment of the inter-joint coordination during gait

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Gait Posture. 2025 Nov 1;124:110030. Online ahead of print

Background: The gait analysis is a relatively commonly used tool for evaluating the functional deficits of various groups of patients, regardless of the origin of these deficits, but is especially common in patients with neurological deficits. One of the problems they encounter is disrupted coordination. One of the methods to assess it is cyclogram, or angle-angle plot.
Research question: Could cyclogram index, based on cyclograms for lower limbs contribute to understanding of the disrupted coordination in neurological patients?
Methods: This paper presents the coordination index, which is based on the perimeters of four cyclograms: hip/pelvis, knee/hip and ankle/knee in the sagittal plane and hip/pelvis in the frontal plane. Data extracted from retrospective gait analyses of patients with spastic diplegia cerebral palsy, dystrophy and Guillain-Barre syndrome were used to calculate cyclograms, coordination index and gait indices: Gillette Gait Index (GGI), Gait Deviation Index (GDI) and Gait Profile Score (GPS).
Results: The main finding of this paper is the independence of the new coordination index from commonly used indices: GGI, GDI and GPS. A discriminant analysis, in which the grouping variable was the name of the disease, revealed that cyclogram perimeters and coordination index were statistically significant predictors.
Significance: Coordination index could be used as additional measure assessing the disrupted coordination in patients.
Conclusion: This paper shows the potential usefulness of the proposed method in clinical application, especially in the long-term changes induced by the various treatment methods.
PMID: 41197188

8.Overground gait training improves the sensorimotor cortical dynamics and mobility of persons with cerebral palsy

Morgan T Busboom, Rachel K Spooner, Liana S Chinen, Sarah E Baker, Brad Corr, Katie L Bemis, Kimberley Scott, Tony W Wilson, Max J Kurz

Neuroimage Clin. 2025 Nov 2;48:103901. Online ahead of print

Abstract
Persons with cerebral palsy (CP) exhibit aberrant sensorimotor cortical oscillations linked to uncharacteristic motor actions and mobility, but the key physical therapy ingredients needed to offset these aberrations and drive improvements in cortical function remain unclear. This study evaluated whether overground gait training results in mobility gains that are coupled to beneficial changes in sensorimotor cortical oscillations in persons with CP. 34 persons with CP (Age = 20.58 ± 7.61 yrs; Gross Motor Functional Classification Scores I–III) and 32 neurotypical (NT) controls (Age = 23.06 ± 3.79 yrs) participated. Persons with CP completed 24 overground gait training sessions (3 days/week for 8 weeks). A battery of clinical assessments were used to examine changes in functional mobility. Magnetoencephalographic (MEG) imaging was used to quantify sensorimotor cortical oscillations while performing a knee extension motor task pre- and post-therapy in the CP group. Only one MEG measurement was completed by NTs. Persons with CP improved their Functional Gait Assessment scores by 8.77% ($p < 0.001$), dynamic range by 38.94% ($p < 0.001$), and Timed Up-and-Go (TUG) time by 15.97% ($p < 0.001$). Post-training, sensorimotor beta oscillations during movement planning and execution became 19.95% stronger ($p < 0.001$), approaching NT levels. Movement-related gamma oscillations became 37.88% weaker ($p = 0.003$) and no longer differed from NTs post-therapy ($ps > 0.05$). Notably, the persons with CP who exhibited the largest increases in sensorimotor beta oscillations tended to have greater improvements in the TUG ($p = 0.025$). Overground gait training enhanced sensorimotor cortical oscillations and yielded clinically meaningful mobility gains. These neuroplastic and functional improvements may stem from gait-related tasks emphasizing movement planning, execution, and problem-solving.
PMID: 41192147

9.High effectiveness of multilevel orthopaedic surgery and guided growth in spastic hemiplegia children

Ulvi Mamedov, Tamara Dolganova, Orkhan Gatamov, Patrick Foster, Akhmed Tomov, Dmitry Popkov

J Child Orthop. 2025 Oct 29. Online ahead of print

Purpose: Objectives were to evaluate if gait was improved after multilevel surgery on the involved leg and simultaneously performed guided growth procedure on the uninvolved leg and whether simultaneously performed guided growth is efficient in limb length discrepancy management in hemiplegic children.
Methods: Gait pattern of 78 hemiplegic children (mean age 10.4 years) was evaluated using instrumented gait analysis before surgery and at 2 years. This study involved children with type 2a (Rodda and Graham classification) – 12, type 3 – 20, type 4 – 23, type 4s (undergone triceps lengthening at early age) – 23.
Results: The mean limb length discrepancy was 2.3 cm before surgery and 0.4 cm at final control. In all patients aged over 144 months, the residual length discrepancy was over 10 mm. The improvement in gait kinematics was observed on both the uninvolved and hemiplegic limbs. Finally, control on uninvolved leg kinematics presented values similar to reference values. On the involved leg, there were significant improvements in sagittal and transverse kinematics. Only patients of the 4s group had no improvements in ankle flexion moment and power generation.
Conclusion: Multilevel surgery including simultaneous guided growth ensures improvements on both the uninvolved and hemiplegic limb gait kinematics. We suggest guided growth surgery before the age of 12 years for more exact equalization. Isolated triceps performed at an early age represent negative conditions for plantar flexion strength development in long term.
PMID: 41181066

10.The Effect of Immediate Weight Bearing After Planovalgus Foot Reconstruction in Ambulatory Children With Cerebral Palsy

Chris Church, Hannah Scott, Madison Lennon, Jose J Salazar-Torres, Jason J Howard, Nancy Lennon, M Wade Shrader, Christina P Herrero, Rachel L Lenhart, Hannah Popper, Abigail Helms, Arianna Trionfo

J Pediatr Orthop. 2025 Nov 3. Online ahead of print

Background: Planovalgus is a common foot deformity in children with cerebral palsy (CP). Orthopaedic surgery is widely established as an effective treatment for planovalgus deformity, but postoperative protocols vary without a clear rationale. Immediate weight bearing (WB) after planovalgus foot correction may accelerate recovery; however, concerns about complications cause reluctance. This study aimed to determine the prevalence of complications after planovalgus correction in children with CP with early WB versus non-WB (NWB).
Methods: This retrospective cohort study included ambulatory children (Gross Motor Function Classification System I to III) with CP and planovalgus foot deformity who underwent reconstructive surgery and pre- and postoperative gait analyses. Complications were defined in 3 timeframes: (1) short-term, within 6 months of surgery, by radiograph review for nonunion, hardware failure, or infection requiring return to surgery; (2) mid-term, at 1 to 3 years, by pedobarographic assessment; and (3) long-term, >3 years, by recurrence requiring surgical revision. Fisher's exact tests compared the prevalence of complications between the immediate WB and NWB groups. Regression analysis was used to evaluate the relationship between complications and child, surgical, and postoperative factors.
Results: One hundred thirty-five children with CP (Gross Motor Function Classification System I–12%, II–58%, III–30%) underwent 140 surgical events (224 feet) at age 12.7±2.8 years. Following surgery, 84% of children followed an immediate WB protocol; 16% were NWB for 6 weeks. The prevalence of short-term complications between the WB and NWB groups was not different (nonunion/hardware failure/infection: WB, 3%/1%/0%; NWB, 0%/3%/0%; $P > 0.9$). No differences existed between groups in midterm correction status (undercorrected/corrected/overcorrected: WB, 31%/45%/24%; NWB, 32%/54%/14%; $P > 0.9$). The prevalence of long-term recurrence necessitating surgery was not significantly different (WB/NWB, 3%/11%; 8.5±2.8 years postoperatively; $P > 0.9$). WB status was not a significant predictor of correction status or long-term recurrence requiring revision ($P \geq 0.11$).
Conclusions: There were no significant differences in complications between groups who followed immediate WB versus NWB postoperative protocols. Immediate WB after planovalgus foot correction surgery should be encouraged in children with CP, as early WB may prevent disuse muscle weakness and promote recovery.
PMID: 41178517

11.Infants and Toddlers With Moderate-To-Severe Cerebral Palsy Receive Very Low Doses of In-Person Rehabilitation

Rachel Bican, Jill Heathcock

Pediatr Neurol. 2025 Oct 15;174:91–96. Online ahead of print

Background: Dose of rehabilitation services is important for optimizing developmental outcomes for children with cerebral palsy (CP). However, little is known about how much in-person rehabilitation infants and toddlers with CP currently receive, and how dose relates to function. The purpose of this study is to describe the dose of in-person rehabilitation services received by infants and toddlers with CP and to evaluate the relationship between physical therapy (PT) dose, age, and gross motor function.
Methods: We enrolled 53 participants (6 months–2 years old) with moderate-to-severe CP, defined as Gross Motor Function Classification System levels III–V. Parent-reported data on outpatient and early intervention PT, occupational therapy, and speech-language pathology services over the past 6 months were used to calculate monthly service dose. The Gross Motor Function Measure, 88-item was administered to quantify motor function.
Results: Participants received very low doses of therapy across disciplines. The mean total hours of rehabilitation services the participants received were between 0.4 and 3.0 hours per discipline per month. Combined in-person services averaged less than 9 total hours per month. There was no relationship found between the total hours of PT the child received and their age ($P = 0.27$, $F = 1.22$) or gross motor function (as measured by the Gross Motor Function Measure, 88-item) ($P = 0.82$, $F = 0.05$).
Conclusions: Infants and toddlers with moderate-to-severe CP receive low doses of in-person rehabilitation, and the dose of PT does not appear to be individualized based on age or functional severity. These findings suggest a need for more tailored, intensive, and family-centered rehabilitation planning in early childhood.
PMID: 41202409

12.The role of osteopathic manipulative medicine in cerebral palsy: bridging treatment gaps and enhancing care

Ambrose Loc Ngo, Niki Gharavi Alkhansari, Rachana Tadakamalla, Mercede Hess, Uyen Tam Nguyen, John Yazji, Robert S Rogers

J Osteopath Med. 2025 Nov 10. Online ahead of print

Abstract
Osteopathic manipulative medicine (OMM) is a hands-on approach utilized by physicians to diagnose, treat, and prevent various conditions through the application of muscle manipulation techniques. It has been applied in managing chronic musculoskeletal (MSK) pain, headaches, migraines, Parkinsonian gait, and psychological conditions such as stress, anxiety, and depression. In our narrative review, we aim to integrate both direct clinical studies of OMM in cerebral palsy (CP) and supportive literature on mechanisms and related conditions. A comprehensive literature search was conducted utilizing PubMed and Google Scholar to identify relevant studies on OMM in CP management. Search strategies were intentionally broad to capture mechanistic, supportive, and clinical evidence. Representative terms included "osteopathic manipulative medicine and cerebral palsy," "osteopathic treatment and neurological disorders," and "manual therapy and cerebral palsy." Additionally, reference lists of relevant articles were manually reviewed to identify additional studies. Overall, we found that integrating OMM into CP management may offer a noninvasive approach to improving MSK function and neuromuscular control while alleviating the emotional and physical challenges, as well as increasing movement to reduce joint contractures associated with the condition. OMM techniques may also help reduce stress, anxiety, and constipation, which are prevalent among CP patients due to the psychological and physiological burdens of the disorder. OMM's holistic approach has the potential to enhance outcomes for individuals with CP by addressing their multifaceted needs. While further research and advocacy are necessary to fully integrate OMM into mainstream CP management, existing evidence suggests that OMM may improve patient outcomes and quality of life. However, the current evidence has remained somewhat limited.
PMID: 41202174

13.Movement Behaviors on Days With and Without Structured Activities in Children With Cerebral Palsy: A Within- and Between-Person Analysis

Rafael Tassitano, Clarice Maria de Lucena Martins, Tracy Bowden, Maria Cecilia Marinho Tenorio, Michael Beets, R Glenn Weaver, Keith Brazendale

J Phys Act Health. 2025 Nov 6:1–8. Online ahead of print

Background: A structured day can positively impact movement behaviors—physical activity, sedentary time, and sleep—among children with cerebral palsy. This study aims to describe and examine the between- and within-person associations of movement behaviors on days with and without structured activities among children with cerebral palsy.
Methods: A cross-sectional study was conducted with 17 children with cerebral palsy. Inclusion criteria were children aged 3–10 years, diagnosed with cerebral palsy, and classified as levels I to III according to the Gross Motor Function Classification System. Movement behaviors were objectively measured using accelerometers over 7 consecutive days. A daily activity log documented the structure of the children's activities. Two-level multilevel linear mixed-effects models were fitted to analyze associations.
Results: A total of 119 days were included in the analyses. Recommendations for sleep, sedentary time (ie, screen time), and physical activity were met on 30.2%, 9.2%, and 6.7% of the days, respectively. More favorable behaviors occurred on days with structured activities compared with days without. Adjusted within-person effects revealed that on days with more structured activities compared with their average days, children accumulated an additional 4.3 minutes of moderate to vigorous physical activity, took 648 more steps, and spent 24.8 fewer minutes on screen time.
Conclusions: The within-person analysis highlights day-to-day patterns and provides a contextual perspective on promoting movement behaviors, regardless of the child's level of impairment. Informing caregivers and families about the benefits of structured activities can support strategies to enhance movement behaviors in children with cerebral palsy.
PMID: 41197611

14.Interlimb Asymmetries in Football Players With Coordination Impairments: Implications for Classification and Training

Matías Henríquez, Kabir P Sadarangani, María Isabel Cornejo, Iván Peña-González, Javier Yanci, Raul Reina

Int J Sports Physiol Perform. 2025 Nov 5:1–7. Online ahead of print

Purpose: Football requires complex motor tasks to be performed under intermittent conditions, often involving asymmetrical movement. In footballers with cerebral palsy (CP), asymmetries are influenced by neuromuscular impairments, yet their role in performance differentiation across sport classes remains unclear. The objective of this study was to quantify interlimb differences and asymmetries in unilateral vertical and horizontal jump and change-of-direction (COD) performance among footballers with CP and to examine variations across different sport classes.
Methods: One hundred thirty-eight international male footballers with CP, classified into FT1, FT2, and FT3 sport classes, performed unilateral countermovement jumps (CMJs), standing broad jumps (SBJs), and the 505 COD test.
Results: Significant interlimb asymmetries were identified in unilateral tests (CMJ and SBJ) across all participants but not in COD performance. Significant interlimb differences were observed in CMJ and SBJ, with FT1 and FT2 showing greater asymmetry compared with FT3, who exhibited the lowest asymmetry percentage in CMJ ($P < .05$, $d = 0.79–0.95$). However, no significant differences were found between sport classes in COD performance or the asymmetry for SBJ and COD tests.
Conclusions: Footballers with CP presented significant interlimb differences in unilateral jumping, with greater asymmetries observed in players from FT1 and FT2 compared with FT3. Interlimb differences can be valuable for optimizing motor performance and the categorization of individuals with CP by impairment impact. These results highlight the relevance of assessing interlimb contributions and asymmetry patterns in motor performance, emphasizing the use of quantitative measures for evaluating impairment impact in footballers with CP.
PMID: 41192413

15.Comparison of hospital admission and antibiotic usage before and after the initiation of long-term respiratory support in children and young people with cerebral palsy: a retrospective cohort study

Dhandayuthapani Rajkumar, Catherine M McDougall, Florian Gahleitner, Mark M Gaston, Helen Sheridan, Steve Cunningham, Donald S Urquhart

Arch Dis Child. 2025 Nov 4. Online ahead of print

Abstract
This retrospective cohort study examined the impact of long-term respiratory support (CPAP or non-invasive ventilation) on hospital admissions and antibiotic usage in children and young people with cerebral palsy (CP). Data from the Cerebral Palsy Integrated Pathway and South-East Scotland sleep study databases were reviewed for the period 2014–2024. Of 713 children with CP, 76 underwent sleep studies, and 10 were commenced on respiratory support. Significant improvements were observed post-initiation: apnoea-hypopnoea index decreased from 14.7 to 0.4, obstructive AHI from 12.6 to 0, and mean oxygen saturation increased from 95% to 97%. These findings suggest that respiratory support may reduce sleep-disordered breathing and improve oxygenation, potentially reducing hospital admissions and antibiotic use.
PMID: 41192955

16.Posterior drooling and saliva aspiration in children with cerebral palsy: hidden threats

Bruno Leonardo Scofano Dias, Fernanda Marinho de Lima

World J Pediatr. 2025 Nov 5. Online ahead of print

Background: Posterior drooling and saliva aspiration are hidden threats to progressive respiratory morbidity in patients with cerebral palsy (CP). This study aimed to identify and synthesize current evidence on the definitions, prevalence, pathophysiology, diagnosis and treatment of posterior drooling and saliva aspiration in children with CP.
Methods: This was a scoping review. The inclusion criteria were articles focused on the objectives of the study; published between January 2000 and June 2025; written in English, Portuguese, Spanish, French or Italian; and whose full texts were available. The PubMed, Virtual Health Library, Scielo, Cochrane Library, Scopus and EMBASE databases were searched.
Results: A total of 1195 citations were identified by our search strategy, with 637 remaining after the removal of 558 duplicates. After screening titles and abstracts, 304 citations progressed to full-text review. A total of 86 articles met the eligibility criteria and were included in the review. While 28 articles were excluded because they lacked access to full texts and/or were not written in the selected languages, only 114 (9.5%) studies involved posterior drooling/saliva aspiration.
Conclusions: A large discrepancy was evident, with a much larger volume of studies on anterior drooling than on posterior drooling/saliva aspiration. This article highlights the need for more research and greater emphasis on these conditions in pediatric clinical practice. Early and reliable diagnosis and proactive interventions are essential to prevent progressive lung injury, lower respiratory tract infections, hospitalizations, impaired quality of life, and premature death.
PMID: 41191295

17.Effect of a Power Mobility Intervention on the Sleep Health of Toddlers with Cerebral Palsy

Bethany M Sloane, Samuel W Logan, John Richmond T Sy, Ruth K Brombach, Avani Stevens-Rose, Jessica R Dietch

Phys Occup Ther Pediatr. 2025 Nov 3:1–14. Online ahead of print

Purpose: Children with cerebral palsy (CP) experience higher rates of sleep disturbances. Power mobility may affect sleep health due to the cognitive activity associated with mobility. This study aims to establish proof-of-concept to examine the effect of a power mobility intervention on the sleep health of young children with CP.
Methods: Toddlers (12–36 months old) with CP completed a 12-week intervention and used the Explorer Mini. Caregivers reported the total number of days and the total duration in minutes of device use. Caregivers also evaluated changes in their child's sleep health.
Results: Spearman's correlations indicated moderate correlations between overall sleep score and Explorer Mini use. Mann-Whitney U tests indicated moderate effect sizes on Explorer Mini use between stable/worse sleep and better sleep groups.
Conclusion: Future work should expand upon this study and examine whether an association exists between power mobility use and sleep health using fully powered statistical analyses.
PMID: 41181890

18.Effects of Robot-Assisted Therapy on Upper Limb Function in Children with Cerebral Palsy: A Systematic Review with Meta-Analysis

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Phys Occup Ther Pediatr. 2025 Nov 3:1–16. Online ahead of print

Aims: To investigate how effective is robot-assisted therapy vs. comparison intervention (no intervention, placebo or a conventional intervention) in improving affected upper limb outcomes (any related to the upper limb function, such as muscle strength, motor coordination, tones, reach, and grasp) in children with cerebral palsy (CP).
Methods: Searches of this systematic review with meta-analysis were conducted on Cochrane, LILACS, MEDLINE, PEDro, and Scielo databases. Studies with children with CP, which delivered robot-assisted therapy on upper limb were included.
Results: Four studies were included. The meta-analysis was performed for all Quality of Upper Extremities Skills Test subscales and muscle tone. Robot-assisted therapy, compared with conventional therapy, improved dissociated movements by 4.3 points (95% CI 0.9 to 7.6, $I^2 = 0\%$, $p = 0.01$), grasp by 5.7 points (95% CI 3.0 to 8.3, $I^2 = 0\%$, $p < 0.001$), and weight bearing by 8.7 points (95% CI 2.2 to 15.2, $I^2 = 0\%$, $p = 0.008$). The quality of evidence for all measures was rated as moderate.
Conclusion: Overall, robot-assisted therapy appears to be effective in improving dissociated movements, grasp, and weight-bearing, but not for muscle tone and protective extension in children with CP. However, these results need to be interpreted cautiously.
PMID: 41181897

19.Common data elements of cerebral palsy registries in Arabic-speaking countries: A scoping review

Nihad Ali Almasri, Carl J Dunst

Dev Med Child Neurol. 2025 Nov 7. Online ahead of print

Aim: To (1) identify and extract common data elements (CDEs) reported in registry- and population-based cerebral palsy (CP) studies in Arabic-speaking countries (ASCs), (2) compare reporting across study designs to ensure consistency of extraction and comparability of CDEs, (3) classify reporting consistency of the CDEs across six categories of frequency of reporting, and (4) assess the alignment of CDEs with data elements from international registry networks.
Method: The review was conducted using the JBI methodology for scoping reviews and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines. The Rayyan web application was used as a screening tool. Thirty-eight studies from 11 ASCs were analyzed. CDEs were extracted and grouped by frequency and thematic domains. Fisher's exact test and Cohen's kappa (κ) measured agreement across study types and with three international CP registry networks.
Results: Across 38 studies, core demographic and clinical CP classification data (age, sex, motor type, and topographical distribution) and birth-related characteristics (gestational age, birthweight, and mode of delivery) were consistently reported. Functional classifications, parental demographics, socioeconomic status, and rehabilitation services were less frequently included, particularly in population-based studies. Agreement with international registries was fair with the Australian Cerebral Palsy Register (κ = 0.26) and Global Low and Middle Income Cerebral Palsy Registers (κ = 0.24), but only slight with the Surveillance of Cerebral Palsy in Europe (κ = 0.17). Twelve elements were consistently reported across ASC studies and all three registry networks, covering demographic, perinatal, and core functional classifications.
Interpretation: ASC studies capture core CP data but remain inconsistent in reporting functional classifications, family context, and rehabilitation services. Establishing a harmonized minimum data set and registry network for ASCs would strengthen data quality, guide evidence-informed policy, and enhance both regional and global research impact.
PMID: 41204647

20.Genetic diagnostic yield by MRI pattern in children with cerebral palsy: a population-based study

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Background: Neuroimaging abnormalities are detected in 80–86% of individuals with cerebral palsy (CP). Lesional white or grey matter injuries (WMI, GMI) are most common and typically attributed to environmental factors, while genetic causes are thought to underlie non-lesional injuries and normal brain imaging. This hypothesis has not been formally tested, and we aimed to evaluate it using the Australian CP biobank.
Methods: This population-based study included 331 children with CP (195 males, 136 females), born between 1986 and 2018. Genomic DNA extracted from blood or saliva samples underwent sequencing, variant filtering, classification using ACMG-AMP criteria, and variant curation. Probands were classified as 'resolved', 'candidate variant(s) identified', or 'no candidate variant identified'. Paediatric radiologists/neurologists coded brain MRI, CT, and ultrasound using the Magnetic Resonance Imaging Classification System (MRICS). Data analyses included descriptive statistics and multinomial logistic regression.
Findings: A genetic aetiology was identified in 80 children (24%), while 165 (50%) had candidate variants and 86 (26%) had no candidate variant identified. Among children with predominant WMI or GMI (50% and 21%, respectively), 19% and 10% were genetically resolved. Children with maldevelopments, miscellaneous findings, or normal neuroimaging (10%, 10%, and 8%, respectively) were more often genetically resolved (41%, 48% and 39%) compared to those with lesional injuries (WMI or GMI), with relative risk ratios (RRR) of 3.54 (95% CI: 1.65–7.59), 4.75 (95% CI: 2.21–10.2), and 3.27 (95% CI: 1.42–7.52), respectively.
Interpretation: These findings support the hypothesis that genetic aetiologies are more common in non-lesional CP. However, genetic diagnoses were observed across all MRICS categories, including 17% of lesional brain injuries. Notably, almost half of all genetically diagnosed children (39 of 80) were in the WMI and GMI groups. Therefore, we emphasise that neuroimaging should be used as a guide, not an exclusion criterion for genomic testing in CP.
PMID: 41202470

21.ICF-based functioning profiles in children and adolescents with cerebral palsy: Evidence from a population-based study in Argentina

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Purpose: In Argentina, there is no consensus on the functional assessment of children with cerebral palsy (CP). The International Classification of Functioning, Disability and Health (ICF) Core Sets for children with CP are tools that standardize clinical functional assessments. The aim was to build functioning profiles of children with CP aged 2 to 18 years in eight Argentine cities, to identify their functional needs and contribute to improving assessment processes.
Methods: Cross-sectional study, developed in stages. This article describes the last stage, the creation of the functional profile of a sample surveyed in eight cities. Twenty-five categories established in the common abbreviated core set of CP were evaluated through the application of a protocol called PC-CIFuncional (previously created). This protocol consists of scales or culturally sensitive instruments, assessed through clinical evaluations and questionnaires for children and families.
Results: One hundred thirty-three functioning profiles were built using the previously developed PC-CIFuncional protocol. Of the participants, 52.7% had severe motor compromise with Gross Motor Function Classification System (GMFCS) levels IV and V. In children at GMFCS level IV–V, most categories in activities and participation—including recreation, communication and physical activity—showed severe limitations and restrictions, compared with their peers. The use of technology for daily living and mobility in children with less motor compromise (GMFCS level I–III) was neither a facilitator nor a barrier, but in children with greater compromise it was a complete facilitator.
Conclusions: Differences in functional needs were identified in children with CP according to motor involvement. This project standardizes the identification of functional needs and therapeutic goals based on ICF language, creating novel functioning profiles in Argentina.
PMID: 41190933

22.Prevalence of hip dislocation and subluxation among children with cerebral palsy: an institution-based cross-sectional study from a Sub-Saharan country

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Background: Hip dislocation in children with cerebral palsy (CP) presents significant challenges, including pain, and severe contractures, which impair positioning, sitting, standing, and walking. This study investigated the prevalence and factors associated with hip displacement in a cohort of children with CP in a resource-limited setting lacking a dedicated hip surveillance program.
Methods: A cross-sectional study was conducted from August 1, 2023, to January 30, 2024, at Tikur Anbesa Hospital, Ethiopia's largest tertiary hospital. The study included 141 children with CP who met the inclusion criteria and underwent hip radiography. The hip migration percentage was assessed, with hip subluxation defined as a migration percentage between 30% and 80% and hip dislocation defined as a percentage greater than 80%. The migration percentages were analyzed in relation to sociodemographic and clinical data via statistical tests.
Results: The study cohort predominantly consisted of children with spastic tetraplegic CP (56.7%), and 52.6% had GMFCS levels IV and V. A high comorbidity rate was observed, with 98% of the children having additional conditions, the most common being epilepsy (59%). The prevalence of hip displacement was 28%, with 88% of these cases classified as hip subluxation and nearly 11% as dislocation. Displacement was more common in the left hip (56.4%) than in the right hip or both hips. Osteopenia was present in 3.5% of the children. Factors associated with hip displacement included home rehabilitation, frequency of carrying by caregivers, GMFCS levels, and being aged 5–10 years.
Conclusions: This study highlights the significant prevalence of hip displacement among children with CP in a resource-limited setting, despite being managed at a tertiary hospital. The findings underscore the need for the implementation of hip surveillance programs and timely interventions to prevent or mitigate hip displacement, thereby enhancing the quality of life and functional outcomes of these children.
PMID: 41184821

23.Impaired expectations: the challenge of ableism in paediatrics

Paige Terrien Church, Rudaina Banihani, Amy Rule, David Frumberg, John Maypole, Ashley Volion, Michael Msall, Peter Rosenbaum

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Abstract
In the field of paediatrics, the concept of normal (ie, typical)-in contrast to different, special, deviant, delayed, or atypical-has imposed a problematic framework within which people view a child with an impairment. This binary perspective oversimplifies a complex, fluid, and dynamic process encompassing physical, behavioural, emotional, cognitive, social, and communicative development. Furthermore, this approach reinforces the notion of a singular normality, diminishing the value of any variation from this assumed (and usually poorly defined and naive) standard, in a way that speaks of ableism-the normative bias that a standard norm exists and anything other than this standard is inferior. Ableism profoundly affects systems, whether they be clinical or medical, educational, or community-based or research-based. The aims of this Personal View are to (1) examine the evolution of disability definitions; (2) challenge the construct of normal in child health; and (3) review identified types of disability. This Personal View explores the literature on ableism in paediatrics from a global perspective, assessing its effect on children, their parents and families, and on the broader community. We offer a modern perspective on disability, embracing the resilience and adaptations that often emerge, while acknowledging challenges. We aim to provide paediatric learners and health-care professionals with opportunities to improve paediatric care through an inclusionary, strengths-based approach to disability that values diverse developmental pathways and challenges rigid normative expectations.
PMID: 41202835

24.Design model for inclusion of resilience in children with cerebral palsy

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Background: Regarding the continuity of life, people with disabilities require various forms of assistance to fulfill their rights to survive and be sustainable. Children with cerebral palsy (CP) disabilities have not yet had their social, economic and environmental rights fulfilled as people with disabilities. This condition drives the need to create an inclusion model for the resilience of children with CP disabilities to provide a competitive advantage in quality and empowered human resources.
Objectives: This study aimed to explore the important factors and strategies for enhancing the resilience of children with CP.
Method: The data used in this study are based on the Penta helix (government, community, practitioners, society and academics). The soft system method was chosen to analyse the study's problems.
Results: Inclusion for resilience in children with CP disabilities has excellent potential to be optimised by managing several important factors, including policies, databases, health, social aspects, infrastructure and education.
Conclusion: This can be achieved through genuine collaboration among key stakeholders: the government, society, medical professionals, communities and academics. With genuine collaboration and implementation, the target of resilience inclusion for children with CP will be achieved with good physical and mental health and quality of life.
Contribution: This study provides new and more comprehensive knowledge about the key factors and strategies to enhance the resilience of children with cerebral palsy disabilities.
PMID: 41200090

25.Cerebral Magnetic Resonance Imaging of Children With Cerebral Palsy Showed Vulnerabilities Related to Gestational Age

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Aim: This study aimed to describe cerebral magnetic resonance imaging (MRI) findings in children with cerebral palsy (CP) and compare them with risk factors and clinical features.
Methods: Data on 1867 children with CP born in 2000–2016 were retrieved from the Norwegian Quality and Surveillance Registry for CP and linked to the Medical Birth Registry. Descriptive statistics were used.
Results: MRI scans were performed in 1463 children, that revealed one predominant pathogenic finding: 44.6% white matter injuries, 28.4% grey matter injuries, 13.5% normal, 7.9% maldevelopments and 5.5% miscellaneous. The proportion of grey matter injuries increased as gestational age increased ($p < 0.01$). However, white matter injuries were more common in children born at term and small for gestational age (SGA) than in those not SGA ($p = 0.03$). In term-born children, grey matter injuries decreased with increasing 5-min Apgar scores ($p < 0.01$). Half of the children with spastic CP had white matter injuries, while half of those with dyskinetic CP had grey matter injuries. White matter injuries were the most common, regardless of the Gross Motor Function Classification System level. Children with epilepsy mainly had grey matter injuries.
Conclusion: This study highlighted the vulnerability of white and grey matter in preterm and term infants with CP, respectively.
PMID: 41195626

26.Fracture Risk Following Hardware Removal in Children With Arthrogryposis

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Background: Children with arthrogryposis often undergo lower extremity long bone osteotomy for improved biomechanical alignment with subsequent hardware removal. The incidence of fracture and infection is unknown in this population. Therefore, the aim of this study was to identify the incidence of these complications following hardware removal and compare them to a matched cohort of patients with cerebral palsy.
Methods: Patients with arthrogryposis aged 0 to 20 years who underwent lower extremity osteotomy with subsequent hardware removal were included. All hardware removal events were recorded and evaluated for postoperative fracture or infection. For comparative analysis, each patient with arthrogryposis was matched 1:1 with a patient with cerebral palsy based on age, osteotomy location, and implant type at the time of the first hardware removal event.
Results: Fifty-three patients with arthrogryposis were included with a total of 73 hardware removal procedures. Postoperative fractures occurred in 9.4% of patients, and infections in 5.3%. When calculated per hardware removal event, the incidence of both fracture and infection was 6.8%. Thirty-seven patients were successfully matched with a cerebral palsy counterpart. There were no differences in infection rates between groups ($P = 1.0$); however, the arthrogryposis cohort sustained 3 fractures postremoval, while no fractures were observed in the cerebral palsy cohort.
Conclusion: Children with arthrogryposis have a relatively high risk of fracture following hardware removal after lower extremity osteotomy. Caution is advised when removing metallic implants in this population.
PMID: 41191822

27.Causal diagrams for research about childhood-onset disabilities

Robert J Reynolds, Shona Goldsmith, Sarah Mcintyre, Steven M Day

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Abstract
Directed acyclic graphs (DAGs) are increasingly used to clarify assumptions, identify sources of bias, and structure reasoning about causal pathways across the health sciences. In developmental medicine, where causes often span the preconception to postnatal periods, DAGs offer a systematic way to navigate complexity. This review introduces foundational DAG concepts for clinicians and researchers in childhood-onset disability, with an emphasis on accessibility and applied relevance. We review examples involving cerebral palsy, autism, and attention-deficit/hyperactivity disorder, showing how DAGs support confounder control, effect estimation, and study design. The figures throughout the review use a consistent, clinically grounded example to walk readers through concepts like mediation, backdoor paths, and collider bias. Beyond modeling rigor, DAGs help foster collaboration across disciplines and communicate causal structure to families and individuals with lived experience. We also show how DAGs can support intervention prioritization by identifying strategic leverage points using network measures such as node centrality and graph characteristics. Finally, we emphasize the importance of drawing DAGs before data collection, when their guidance is most actionable.
PMID: 41191638

28.Unmet needs, underfunded science: A call for investment in cerebral palsy research across the lifespan

Laurie Glader, Theresa Sukal-Moulton; Lifespan Care Committee; Advocacy Committee; Research Committee; Community Council

Dev Med Child Neurol. 2025 Nov 2. Online ahead of print

Abstract
Not available.
PMID: 41177929

Prevention and Cure

29.The urgent search for predictive biomarkers in the emerging era of universal congenital cytomegalovirus screening

Mark R Schleiss

Philos Trans R Soc Lond B Biol Sci. 2025 Nov 6;380(1938):20240434. Epub 2025 Nov 6

Abstract
In utero acquisition of cytomegalovirus (CMV) represents the most common infectious cause of paediatric developmental disability. With a global prevalence of approximately 0.7%, congenital CMV (cCMV) infection can produce wide-ranging injury to the developing fetal and neonatal central nervous system, leading to microcephaly, intracranial calcifications, neuronal migration defects and damage to the developing cochlea and retina. Clinical sequelae include cerebral palsy, seizure disorder, intellectual disabilities, developmental delay, autism spectrum disorders, sensorineural hearing loss (SNHL) and visual impairment. It has been generally believed that most cCMV infections are asymptomatic in nature, and are not associated with long-term neurodevelopmental impairment. This dogma, however, has been called into question in the context of several state and provincial universal cCMV screening programmes that have been implemented in recent years in the United States and Canada. Moreover, the full spectrum of neurodevelopmental sequelae amongst asymptomatic cCMV cases is just starting to be recognized. Host and/or viral factors that predict which asymptomatic infants will have sequelae, including SNHL, are unknown. This review summarizes the current state of the art with respect to the search for predictive biomarkers that can inform the prognosis of asymptomatic cCMV, and aid in decision-making about therapeutic intervention.
PMID: 41194669

30.Do systemic steroids impact survival free of cerebral palsy in preterm infants at risk for bronchopulmonary dysplasia?

Catherine A Duncan, Rosey E Zackula, Talkad S Raghuveer

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Abstract
This comparative effectiveness study used weighted meta-regression to analyze 26 randomized clinical trials involving preterm infants (<30 weeks gestation) who received systemic postnatal corticosteroids (Dexamethasone or Hydrocortisone) to prevent bronchopulmonary dysplasia (BPD). The primary outcome was survival free of cerebral palsy (SFCP). The full meta-regression model showed no significant overall effect of corticosteroids on SFCP. However, subgroup analysis revealed that Dexamethasone was associated with improved SFCP in infants at high risk of BPD, and possible harm in those at low risk. Hydrocortisone showed no significant benefit. These findings suggest that steroid type and baseline BPD risk influence outcomes, and that Dexamethasone may be beneficial when BPD risk is high.
PMID: 41193648

31.Umbilical cord blood: a comprehensive review of protective and restorative properties in clinical applications – a narrative review

Emmanuel Ifeanyi Obeagu

Ann Med Surg (Lond). 2025 Aug 29;87(10):6618–6625. eCollection 2025 Oct

Abstract
Umbilical cord blood has emerged as a valuable biological resource rich in hematopoietic stem and progenitor cells, offering promising therapeutic potential in regenerative medicine, hematologic disorders, and immune modulation. Compared to bone marrow and peripheral blood stem cells, UCB demonstrates several clinical advantages, including lower risk of graft-versus-host disease (GVHD), increased tolerance for human leukocyte antigen (HLA) mismatch, and rapid availability. Transplantation success rates with UCB have improved significantly, with recent studies reporting overall survival rates of 60–70% in pediatric hematopoietic stem cell transplant recipients and 55–65% in adult recipients, particularly in malignant conditions. The incidence of acute GVHD following UCB transplantation ranges from 20% to 40%, while chronic GVHD occurs in approximately 10–20% of cases—lower than rates observed with other stem cell sources. Moreover, UCB-derived stem cells are being investigated for their regenerative and immunomodulatory capabilities in conditions such as cerebral palsy, type 1 diabetes, and ischemic injury, with early-phase trials showing encouraging safety and efficacy profiles. Despite these advancements, disparities in cost-effectiveness and accessibility remain pressing issues. Public cord blood banks offer greater equity in access and have facilitated most unrelated transplants, whereas private banks, often costly, primarily serve families for autologous use with limited clinical indication. This review provides a comprehensive analysis of the biological underpinnings, clinical applications, and outcomes associated with UCB-based therapies, while highlighting ongoing challenges in global access, standardization, and therapeutic scalability.
PMID: 41181451