Cerebral palsy research news

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Interventions and Management

1.Relationships between arm nerve signals measured by somatosensory evoked potentials and functional testing in unilateral cerebral palsy

Guillaume Zavard, Laura Routier, Fabrice Wallois, Jean-François Catanzariti, Séverine Fritot, Emeline Cailliau, Laurent Béghin, Laurence Gottrand

Neurophysiol Clin . 2025 Jun 26;55(4):103089. doi: 10.1016/j.neucli.2025.103089. Online ahead of print.

No abstract available
PMID: 40578065

2.Comprehensive Examination of Upper-Extremity Spasticity

Christopher S Crowe, Peter C Rhee, Caroline Leclercq

Review J Hand Surg Am . 2025 Jun 27:S0363-5023(25)00196-0. doi: 10.1016/j.jhsa.2025.03.026. Online ahead of print.

Abstract
Spasticity is characterized by heightened muscle tone with exaggerated stretch reflexes and represents a prominent feature of upper motor neuron syndrome. This condition leads to a spectrum of upper limb deformities based on underlying pathology, location and severity of the causative lesion, presence of concomitant contracture, and prior treatment. Because of the heterogeneous presentation of the spastic upper limb, a uniform approach to assessment is a critical component of caring for patients with upper motor neuron syndrome. Unfortunately, existing scientific literature lacks consistent diagnostic standards, thereby preventing effective comparison of outcomes. A minimum set of evaluation criteria should be employed to both clarify clinical communication and improve postoperative outcomes reporting. This review outlines a stepwise approach to evaluation, a guide for standardizing measurements, and explores how diagnostic findings influence surgical decision-making in upper limb spasticity.
PMID: 40576600

3.Constraint-Induced Movement Therapy Versus Bimanual Training to Improve Upper Limb Function in Cerebral Palsy: A Systematic Review and Meta-Analysis of Follow-Ups

Gabriel Martin-Moreno, Marta Moreno-Ligero, Alejandro Salazar, David Lucena-Anton, Jose A Moral-Munoz

Review Children (Basel) . 2025 Jun 19;12(6):804. doi: 10.3390/children12060804.

Abstract
Background/Objectives: Constraint-induced movement therapy (CIMT) and bimanual training (BIT) have been commonly used to improve upper limb (ULF) in paediatric populations. This study aimed to compare the efficacy of CIMT and BIT for the recovery of ULF in youth with unilateral cerebral palsy (CP) in the immediate, short, and long term. Methods: A systematic review with a meta-analysis of randomised controlled trials (RCTs) from the PubMed/Medline, Scopus, Web of Science, and PEDro databases was conducted. The primary outcomes were the immediate, short-, and long-term effects on ULF, and the secondary outcomes were related to occupational performance and disability. The risk of bias was assessed using the Cochrane RoB 2.0 tool by two researchers independently. Meta-analyses were performed using RevMan 5.3. Results: From the 174 records obtained, 10 RTCs comprising 418 participants were included. Favourable results were observed immediately after intervention for CIMT regarding unimanual ULF using the Quality of Upper Extremity Test (QUEST) (SMD = 1.08; 95% CI = (0.66;1.50)) and Jebsen-Taylor Hand Function Test (JTHFT) (SMD = -0.62; 95% CI = (-1.23;0.00)). These results were maintained in the short term for the QUEST for dissociated movements (SMD = 1.19; 95% CI = (0.40;1.99)) and in the long term for the JTHFT (SMD = -0.38; 95% CI = (-1;0.24)). Conversely, favourable results were obtained immediately after the intervention for BIT regarding bimanual ULF using the Assisting Hand Assessment (SMD = -0.42; 95% CI = (-0.78-0.05)). Conclusions: CIMT could be more effective for improving unimanual ULF and BIT in youth with unilateral CP. The differences between the interventions decreased in the long term. Nevertheless, these findings should be interpreted with caution due to the variability in the intervention programmes. Further research with standardised protocols is needed.
PMID: 40564762

4.Hand-arm bimanual intensive therapy versus modified constraint-induced movement therapy in children with hemiparetic cerebral palsy: A randomized controlled trial

Prateek Kumar Panda, Indar Kumar Sharawat, Diksha Gupta, Achanya Palayullakandi, S Senthil Kumaran, Poonam Sherwani, Suthiraj Sopanam, Osama Neyaz

Brain Dev . 2025 Jun 18;47(4):104381. doi: 10.1016/j.braindev.2025.104381. Online ahead of print.

Introduction: Modified Constraint-Induced Movement Therapy (mCIMT) and Hand-Arm Bimanual Intensive Therapy (HABIT) are widely used for treating hemiparetic cerebral palsy (CP). Prior randomized controlled trials (RCTs) comparing these approaches yielded mixed outcomes.
Methods: This RCT evaluated the efficacy of 12 weeks of mCIMT versus HABIT in children aged 5-18 years with hemiparetic CP. Primary objective was to compare improvements in upper limb function (quality of upper extremity skills test [QUEST] total score) in both groups. Secondary objectives were to compare speed of upper limb movements (nine-hole peg board test), muscle strength (thumb strength and hand grip strength), quality of life (CPQoL), compliance to advised therapy in both groups, sustenance of improvement 4 weeks after stopping supervised treatment, and to describe and compare diffusion tensor imaging (DTI) and resting functional magnetic resonance imaging (fMRI) changes. Both groups received 2-h supervised sessions, 8 sessions over 4 weeks, followed by weekly sessions for 8 more weeks. Participants practiced 2 h daily at home, monitored by activity logs and videos when feasible.
Results: Each group had 30 participants. Changes in QUEST total scores after 12 weeks were comparable between HABIT and mCIMT (12.00 ± 7.52 vs. 11.35 ± 7.10, p = 0.48). Individual QUEST domain scores, nine-hole peg test times, thumb and grip strength, and CPQoL improvements were also similar between groups (p>0.05 for all). Both groups showed significant improvements across all outcomes at 12 weeks (p<0.05), maintained at 16 weeks. DTI revealed comparable changes in apparent diffusion co-efficient and fractional anisotropy values in the contralateral corticospinal tract (p = 0.63 and 0.71, respectively). fMRI showed increased activation in the contralateral sensorimotor cortex in both groups at 12 weeks.
Conclusion: HABIT and mCIMT demonstrate similar efficacy for upper limb function improvement in children with hemiparetic CP.
PMID: 40554137

5.The Japanese Version of the Quality of Upper Extremity Skills Test

Sayaka Katori, Nobuaki Himuro, Masaki Miura, Yukihiro Kitai, Ryo Tanabe, Hirofumi Ohnishi

OTJR (Thorofare N J) . 2025 Jun 18:15394492251349161. doi: 10.1177/15394492251349161. Online ahead of print.

Abstract
To improve upper-limb function in children with cerebral palsy (CP), adequate assessment tools are essential for rehabilitation; however, there have been very few assessment tools with acceptable validity and reliability for use in Japan to date. The aim of this study was to describe the process of translating the Quality of Upper Extremity Skills Test (QUEST) into Japanese and to examine its psychometric properties. The QUEST was translated using a forward-backward method. Sixty-one children aged 2-18 years with a diagnosis of CP underwent assessment, with video-based reliability assessments conducted for 38 of them. The intra-class correlation coefficients were 0.94 for inter-rater reliability and 0.97 for intra-rater reliability. The total score showed a strong correlation with the Manual Ability Classification System ($\rho = -0.65$). A questionnaire of experts showed generally good content validity. The Japanese version of the QUEST was found to be both valid and reliable.
Plain language summary
Translation, Reliability, and Validity of the Japanese Version of the Quality of Upper Extremity Skills Test for Children With Cerebral PalsyTo improve hand function in children with cerebral palsy (CP), adequate assessment tools are essential for rehabilitation; however, to date, here have been very few tools for measuring or evaluating hand function with acceptable validity and reliability available for use in Japan. The Quality of Upper Extremity Skills Test (QUEST) is one such standardized measure for evaluating hand function of children with CP. The aim of this study was to describe the process of translating the English version of the QUEST into Japanese and to examine its validity and reliability. The QUEST was translated using an internationally recognized translating process. Sixty-one children aged 2–18 years with a diagnosis of CP subsequently underwent QUEST assessment, with video-based reliability assessments conducted for 38 of them. This study has clarified that the Japanese version of the QUEST can accurately and reliably assess the hand function of children with CP. If the Japanese version of the QUEST becomes widely used, children with CP and their families will be able to receive accurate hand function assessments anywhere in Japan, leading to a better understanding of their condition, appropriate goal setting, and application of effective rehabilitation programs. For occupational therapists, The Japanese version of the QUEST will be a useful tool for the assessment of hand function across disciplines and without the need for special training or expensive equipment. In addition, the use of a globally standardized assessment tool will enable high-quality clinical research concerning hand function to be disseminated from Japan in the future.
PMID: 40528615

6.A prospective gait follow-up study 30 years after selective dorsal rhizotomy

Nelleke G Langerak, Christopher L Vaughan, A Graham Fieggen, Warwick J Peacock, Shane E Brassell, Tom F Novacheck, Johannes M N Enslin, Robert P Lamberts

J Neurosurg Pediatr . 2025 Jun 20:1-10. doi: 10.3171/2025.3.PEDS24520. Online ahead of print.

Objective: Selective dorsal rhizotomy (SDR) is a neurosurgical procedure to reduce spasticity in the lower extremities of children with cerebral palsy (CP). The aim of this study was to evaluate gait 30 years after SDR in a prospectively studied cohort to provide clinicians and parents/caregivers with information about the long-term outcomes of this surgery.
Methods: This cohort was assessed preoperatively with 2D gait analysis in 1985 and followed up at 1 and 3 years postoperatively (short-term outcomes) and at 10, 20, and 30 years postoperatively (long-term outcomes). In the current study, these 2D data were reinforced with 3D gait analysis, including gait graphs, 17 kinematic parameters, and Gait Deviation Index (GDI).
Results: Twelve adults with a mean (SD) age of 37.5 (3.3) years with spastic diplegic CP (Gross Motor Function Classification System levels I, II, and III in 4, 6, and 2 patients, respectively) who showed changes in the 2D gait parameters in the short term demonstrated stabilization of hip and knee range of motion and nondimensional temporal distance parameters in the long term (20-30 years), while hip and knee midrange values approached normative values. Although 3D gait analysis showed some abnormal parameters, 9 of the 17 kinematic parameters were within the normal range with a mean (SD) GDI of 73.6 (14.4).
Conclusions: The reduction in lower extremity muscle tone demonstrated on short-term follow-up was sustained in the long term, with some gait parameters approaching the norm in adulthood. Thirty years after SDR, adults with CP walked with a mild crouch gait and no signs of spasticity.
PMID: 40540792

7.The Effect of Core Stabilization Exercises on Upper Extremity Function and Balance in Children with Cerebral Palsy: A Randomized Controlled Trial

Kübra Ecem Küçük, Cigdem Cekmece

Healthcare (Basel) . 2025 Jun 17;13(12):1454. doi: 10.3390/healthcare13121454.

Abstract
Aim: This study explores the effects of core stabilization exercises on balance and upper extremity functions-both unilateral and bilateral-in children with cerebral palsy (CP). Method: Thirty-six children with CP (aged 5-12) were randomly assigned to a study group (n = 18) or control group (n = 18). Both groups received four weeks of physiotherapy and occupational therapy. The study group additionally performed ~45 min of daily core stabilization exercises. Outcome measures included the Box and Block Test (BBT), Assisting Hand Assessment (AHA), Pediatric Berg Balance Scale (PBBS), and Trunk Control Measurement Scale (TCMS). (ClinicalTrials.gov ID: NCT06973213). Results: No significant baseline differences were found between the groups ($p > 0.05$). Post-intervention, the study group showed significant improvements in PBBS ($p = 0.011$), TCMS static sitting ($p = 0.003$), dynamic reaching ($p = 0.037$), and total score ($p = 0.044$). Between-group differences remained non-significant for BBT, AHA, and TCMS selective movement control ($p > 0.05$). Within-group analysis revealed significant gains in BBT (median = 7), PBBS (median = 8), TCMS total (median = 12), static sitting (median = 3.5), and selective movement (median = 6) (all $p < 0.001$). AHA showed a near-significant trend (median = 6, $p = 0.051$). Conclusions: Core stabilization exercises significantly enhance balance and unilateral upper extremity function in children with CP. However, they show limited impact on bimanual function. Integration of these exercises into rehabilitation programs may optimize motor outcomes.
PMID: 40565481

8.TRUNK CONTROL BALANCE AND UPPER EXTREMITY FUNCTION IN AMBULATORY CHILDREN WITH DIPLEGIC CEREBRAL PALSY: A COMPARATIVE STUDY

Burcin Ugur Tosun, Ozge Gokalp, Gulhan Yilmaz Gokmen, Emine Handan Tuzun

Dev Neurosci . 2025 Jun 25:1-22. doi: 10.1159/000547129. Online ahead of print.

Introduction: This study aimed to investigate trunk control, balance, and upper extremity skills quality in ambulatory children with diplegic cerebral palsy (CP) classified as Gross Motor Function Classification System (GMFCS)-I and -II, as well as to compare the GMFCS groups among themselves and with healthy children.
Methods: Twenty-five children with spastic diplegic CP (11.80 ± 2.66 years) and 30 healthy children (13.57 ± 3.48 years) were included. Functional levels were classified with the GMFCS, with 13 children classified as GMFCS-I and 12 as GMFCS-II, while trunk control was assessed with the Trunk Control Measurement Scale (TCMS), balance with the Single-Leg Stance and Four Square Step Tests, and upper extremity functionality with the Quality of Upper Extremity Skills Test (QUEST).
Results: There was no significant difference in age, body mass index, or gender distribution between the CP and control groups ($p > 0.05$). The healthy group outperformed both CP groups in all clinical evaluations. No significant differences were found between GMFCS-I and GMFCS-II groups in the Single-Leg Stance Test, Four Square Step Test, and QUEST parameters ($p > 0.05$). However, TCMS subdomains-static sitting ($p = 0.009$), dynamic reaching ($p = 0.018$), selective movement control ($p = 0.012$), and total scores ($p = 0.006$) were significantly higher in the GMFCS-I group. A moderate positive correlation and a 54% regression rate were observed between the QUEST and TCMS scores.
Conclusion: Trunk control is a key determinant of upper extremity skill quality in children with CP. Core stabilization should be prioritized to improve upper extremity functionality and manage disability levels effectively.
PMID: 40562011

9.Guarded Outcomes After Hip Hemiarthroplasty in Patients with Cerebral Palsy: Highlighting a Personalized Medicine Approach to Mitigate the Risk of Complications

Ahmed Nageeb Mahmoud, Nicholas R Brule, Juan D Bernate, Mark A Seeley, Michael Suk, Daniel S Horwitz

J Pers Med . 2025 Jun 15;15(6):252. doi: 10.3390/jpm15060252.PMID: 40559114 PMCID: PMC12194685 DOI: 10.3390/jpm15060252

Abstract
Background: The effectiveness of hip hemiarthroplasty in managing femoral neck fractures in individuals with cerebral palsy has seldom been reported. Objectives: Given the complex neuromuscular issues associated with cerebral palsy (CP), this retrospective study aims to document the outcomes and characterize the complications of hip hemiarthroplasty for fractures of the femoral neck in a series of patients with CP, emphasizing the role of precision medicine in management. Methods: Six cases of hip hemiarthroplasty in six male patients with cerebral palsy and displaced femoral neck fractures have been reviewed in this study. The patients' mean age at the time of surgery was 55.6 ± 14.1 years (range, 33-71). All the patients were independent indoor ambulators before their femoral neck fracture and had various medical comorbidities. Five patients had intellectual disabilities. Results: The mean clinical and radiographic follow-ups for the patients included in this series were 91.5 and 71.3 months, respectively. All the patients developed significant heterotopic ossification (HO) around the operated hip, which was observed as early as the second week postoperatively on radiographs. HO progressed throughout the follow-up for all the patients. One patient had an early postoperative dislocation with femoral stem loosening, which was managed by implant revision. Another patient had an acetabular protrusion, leading to the loss of their weight-bearing ability and mobility due to pain. Four patients were deceased at a mean of 86.5 months after the index surgery. Conclusions: After considering the preliminary evidence provided with this small case series, this study suggests the overall guarded outcomes of hip hemiarthroplasty in patients with CP. Given the 100% rate of heterotopic ossification, a precision medicine framework with consideration for HO prophylaxis may be recommended after hip hemiarthroplasty in patients with CP. It may also be reasonable to scrutinize a personalized risk assessment approach in this patient subset regarding decision making, surgical approach, and rehabilitation program. The clinical outcomes and the risks of complications following hemiarthroplasty should be sensibly presented to patients with cerebral palsy and their caregivers to achieve reasonable postoperative expectations.
PMID: 40559114

10.Ambulant children with cerebral palsy have similar leg muscle moment arms to typically developing children

Bart Bolsterlee, Brian V Y Chow, Catherine Morgan, Iona Novak, Caroline Rae, Suzanne Davies, Ann Lancaster, Rodrigo R N Rizzo, Claudia Y Rizzo, Robert D Herbert

J Biomech . 2025 Jun 19:189:112828. doi: 10.1016/j.jbiomech.2025.112828. Online ahead of print.

Abstract
Many children with cerebral palsy (CP) have muscle contractures and bony deformities. It has been hypothesised that these musculoskeletal abnormalities could increase or decrease muscle moment arms and cause movement dysfunction. In this study, we first investigated the relationship between skeletal growth (tibia length) and three-dimensional measurements of Achilles tendon and tibialis anterior moment arms from magnetic resonance images of 200 typically developing children aged 5 to 15 years. Moment arms increased linearly with tibia length. To determine whether cerebral palsy affects moment arms, we also measured Achilles tendon and tibialis anterior moment arms from a predominantly ambulant cohort of 79 children with CP (94% Gross Motor Function Classification System Level I or II). After adjusting for tibia length, age and sex, the Achilles tendon moment arms of children with cerebral palsy were, on average, slightly greater than those of typically developing children (mean difference 1.4 mm, 95% confidence interval (CI) 0.4 to 2.4; $p < 0.01$) and tibialis anterior moment arms were slightly smaller (mean difference -0.9 mm, 95% CI -1.6 to -0.2, $p < 0.05$). We conclude that moment arms scale linearly with tibia length during childhood development from 5 to 15 years. Ambulant children with cerebral palsy have moment arms that differ slightly, on average, from the moment arms of typically developing children, but those differences are too small to cause significant ankle joint dysfunction.
PMID: 40544694

11.Changes in Motor Function in a Child with Cerebral Palsy Following Multiple Botulinum Toxin Injections: A Case Report

Nancy Lennon, Chris Church, Jose J Salazar-Torres, Faithe Kalisperis, Freeman Miller, Jason J Howard

Case Reports Children (Basel) . 2025 Jun 12;12(6):761. doi: 10.3390/children12060761.

Abstract
Objective: The objective of this study was to examine 7 years of clinical physical therapy measures in a child with spastic diplegic cerebral palsy (CP) who received multiple botulinum toxin type A (BoNT-A) injections. Methods: A boy diagnosed with spastic diplegic CP, Gross Motor Function Classification System level II, received four episodes of BoNT-A from ages 4 to 10 years. Serial clinical measures of muscle strength, spasticity, lower extremity passive range of motion, gait kinematics, and gross motor function were collected in the gait analysis lab from age 3 to 10 years. Results: After improvements from ages 3 to 7 years, gait and motor function declined from ages 8 to 10 years with no improvement in spasticity or range of motion measurements. Muscle testing and gait kinematics defined a loss of plantarflexion strength. Conclusions: A decline in gross motor skills and gait is not typical for a child with spastic diplegia at age 8 years and its association with BoNT-A injections needs to be considered. This case demonstrates the importance of evaluating treatment outcomes for youth with spastic CP utilizing a set of reliable, and clinically useful measures of strength, spasticity, contracture, gait, and motor function. Critical examination of impairment and functional level measures defines goals, guides treatment, and evaluates outcomes. With this approach, pediatric therapists can empower families to make well-informed decisions.
PMID: 40564719

12.From Inactivity to Activity: Passive Wheelchair Bike Rides Increase Trapezius Muscle Activity in Non-Ambulant Youth with Disabilities

Lisa Musso-Daury, Celia García-Chico, Susana López-Ortiz, Saúl Peñín-Grandes, Diego Del Pozo-González, Rosa Ana Sánchez-García, Laura Marín-Varela, Carmen Matey-Rodríguez, Alejandro Santos-Lozano

Children (Basel) . 2025 Jun 17;12(6):792. doi: 10.3390/children12060792.

Abstract
Background/Objectives: Children at Gross Motor Function Classification System (GMFCS) levels IV and V experience severe motor impairments, yet the effects of passive wheelchair rides on their physiological parameters remain unexplored. This study aimed to examine the acute physiological response to passive bike in non-ambulant children with physical disabilities. Methods: This quasi-experimental study included 24 non-ambulant participants with cognitive impairments (6-21 years old, 50% female). After a 10-min rest, participants underwent a 10-min passive wheelchair bike. Muscle activity, oxygen consumption, and heart rate variability were assessed. Results: Passive bike rides significantly increased muscle activity in the right upper ($p = 0.050$), left upper ($p = 0.008$), and left lower trapezius ($p = 0.038$), with increases of 97-112%. However, no significant changes were observed in oxygen consumption or cardiorespiratory parameters. Conclusions: This study suggests that passive wheelchair bike rides increase trapezius muscle activity in children with severe disabilities at GMFCS levels IV and V, offering potential benefits for this population.
PMID: 40564750

13.Comparative Analysis of In-Match Physical Requirements Across National and International Competitive Contexts in Cerebral Palsy Football

Juan Francisco Maggiolo, Juan José García-Hernández, Manuel Moya-Ramón, Iván Peña-González

Comparative Study Sensors (Basel) . 2025 Jun 19;25(12):3834. doi: 10.3390/s25123834.

Abstract
This study aimed to compare in-match physical and technical requirements of cerebral palsy (CP) football players across different national and international competitive contexts. A total of 79 male outfield players participated in 62 official matches across 3 competitive phases of the Spanish National CP Football League (Regular Phase, Consolation Phase, and Playoffs) and the IFCPF World Cup. Inertial measurement units (IMUs) were used to record locomotor and technical variables during each match. A subset of 10 players was tracked across all phases. Physical demands were normalized per minute of play and analyzed using one-way and repeated-measures ANOVAs. Results revealed that physical requirements during the World Cup were up to three times higher than during national-level matches, with significantly greater maximum velocities, high-intensity distances, and frequencies of accelerations and decelerations ($p < 0.001$, $\eta p2 > 0.40$). Playoffs also imposed significantly greater physical requirements compared to Regular and Consolation Phases. International matches showed a markedly higher number of ball contacts, indicating increased technical involvement. These patterns were consistent in both the full sample and the longitudinal subsample, suggesting that competitive level-rather than player characteristics alone- strongly modulates physical output during the competition. These findings underscore the need for context-specific training and load management strategies to prepare athletes for the elevated demands of high-level CP football competition.
PMID: 40573721

14.Better together: participatory action research for co-constructing an intervention to enhance leisure activities in non-ambulatory adolescents with cerebral palsy

Caline Jesus, Isabelly Cristina Rodrigues Regalado, Ilma Menezes, Rafael Coelho Magalhães, Marcílio de Oliveira Lima Júnior, Karolinne Souza Monteiro, Egmar Longo

Res Involv Engagem . 2025 Jun 20;11(1):69. doi: 10.1186/s40900-025-00684-5.

Background: Adolescents with cerebral palsy (CP) classified at levels IV and V of the gross motor function classification system (GMFCS) face significant restrictions in participating in leisure activities. Involving the public in the development of interventions is a recommended practice. Tools such as the Involvement Matrix (IM) can facilitate collaborative research. The aim of this study was to co-design an intervention to improve leisure activity participation in adolescents with CP at GMFCS levels IV and V, in collaboration with the adolescents, their families, and healthcare professionals.
Methods: This study employed a participatory action research (PAR) approach, involving five adolescents with CP at GMFCS levels IV and V, their mothers, three physiotherapists, and two occupational therapists. Different dialogue groups were formed to facilitate the co-creation of the intervention. The IM guided participant engagement, while the participation and environment measure-children and youth (PEM-CY) was used to assess the adolescents' community participation. Through the dialogue groups, discussions were conducted to identify barriers to participation and collaboratively design an intervention that reflected the preferences of the target audience.
Results: The "Leisure on Wheels" intervention was developed to address the participation barriers identified in the dialogue groups. The results focused on the development process, emphasizing collaborative discussions and adjustments to meet the target audience's needs. The intervention components were tailored to the participants' preferences. To ensure clarity and replicability, the intervention was described using the template for intervention description and replication (TIDieR) checklist. The goal attainment scaling (GAS) was used to define individualized objectives based on the participants' preferences and needs. Feedback from an external group, including two adolescents with CP and their mothers, validated the intervention's relevance and acceptability. The intervention was planned for a four-week period, including weekly 60-min in-person sessions at a selected leisure location and 20-min remote consultations to monitor progress and adjust strategies.
Conclusions: This study highlighted the perceived effectiveness of the co-design model and participatory approach, which facilitated the adaptation of the intervention to the specific needs of adolescents and their families, enhancing its relevance and acceptability.
Trial registration: Ethics Committee of the Federal University of Rio Grande do Norte/Trairi Health Sciences School (UFRN/FACISA) (Opinion Number: 51319321.1.0000.5568).
Plain language summary
This study shows how important it is to involve adolescents with Cerebral Palsy (CP) in creating better interventions. Adolescents with CP who cannot walk face many challenges in participating in leisure activities. Often, the treatments they receive do not focus on helping them join these activities. In this study, five adolescents with CP, their families, and five healthcare professionals worked together to create an intervention to help these adolescents participate in leisure activities. We used special tools to keep everyone involved and to understand how the adolescents participated in community activities. We held group discussions to plan the intervention together. The intervention includes parts that were planned by all participants and was organized using a checklist. After several meetings, we developed a four-week intervention with weekly 60-minute face-to-face sessions at a chosen leisure location and 20-minute remote consultations with a healthcare professional. This study highlights the importance of working together and personalizing interventions for adolescents with CP to make them more effective and relevant.
PMID: 40542452

15.A review about muscle focal vibration contribution on spasticity recovery

Luigi Fattorini, Vito Enrico Pettorossi, Enrico Marchetti, Angelo Rodio, Guido Maria Filippi

Review Front Neurol . 2025 Jun 4:16:1579118. doi: 10.3389/fneur.2025.1579118. eCollection 2025.

Introduction: This review analyses the benefits of focal muscle vibration (FV) in the treatment of spasticity enhancing current understanding and promoting sustained improvements in motor function. Findings could support the selection of optimal FV protocols, guide future research, and provide insights into the mechanisms by which FV may improve motor function in individuals with spasticity.
Methods: A systematic search was conducted using the online databases PubMed, Web of Science, and The Cochrane Library. Including criteria: (a) participants presented with chronic spasticity; (b) the intervention involved the application of localized mechanical vibration; and (c) outcomes included neuromuscular functional parameters. Data extraction was performed independently by four reviewers, using a modified version of the 16-item Downs and Black checklist.
Results: A total of 20 studies were selected, most of which investigated on spasticity following stroke, as well as in conditions such as cerebral palsy, multiple sclerosis, and Minamata syndrome. FV effects were assessed using several methodologies: functional scales, digital analysis and electrophysiological evaluations. After-effects were positive and significant in 19 studies, while one study found non-significant results. In three studies, follow-up durations ranged between 1 and 30 days, and exceeded 1 month in seven. When adequate tests were performed, improvements extended to untreated muscles and involved complex motor behaviors.
Discussion: The after-effects of FV appear to be most relevant and long-lasting when a high-frequency (75-120 Hz), small-amplitude sinusoidal vibrations are repeatedly applied. The observed enduring improvements in complex motor behaviors suggest the involvement of sensory-motor mechanisms. These findings are discussed in the context of previous studies on FV.
PMID: 40534747

16.Adapting two pain assessment tools for young people with cerebral palsy: a multi-stakeholder consensus study

Meredith G Smith, Rachel J Gibson, Remo N Russo, Adrienne R Harvey

Pain Rep . 2025 Jun 25;10(4):e1304. doi: 10.1097/PR9.0000000000001304. eCollection 2025 Aug.

Introduction: Cerebral palsy (CP) is the most common cause of childhood physical disability. Chronic pain is a common comorbidity of CP; however, holistic pain assessment is challenging due to few available self-report tools for people with CP and diverse cognitive, communication, and functional abilities. Previous research has identified 2 tools for potential use in CP (Fear of Pain Questionnaire for Children-Short Form [FOPQ-C-SF] and Modified Brief Pain Inventory [mBPI]), along with potential modifications.
Objectives: To gain consensus on modifications required to the FOPQ-C-SF and mBPI for use with children and young people with CP and chronic pain.
Methods: A 2-round modified electronic Delphi study with people with lived experience (n = 19 and 16) and clinicians (n = 25 and 21) was conducted. Ethics was obtained through the Women's and Children's Health Network Human Research Ethics Committee (2022/HRE00154). A total of 37 modification suggestions to the FOPQ-C-SF and mBPI were rated on a 5-point Likert scale (strongly agree to strongly disagree). Consensus was determined as ≥75% of participants rating the suggestion as strongly agree/agree, or strongly disagree/disagree.
Results: Seven modifications reached consensus for inclusion in the FOPQ-C-SF and 21 for the mBPI. No modifications reached consensus for exclusion for either tool. Modifications primarily focused on refining wording, enhancing visual representation of the tool for improved understanding and reducing the number of response options.
Conclusion: Consensus has been reached on modifications to the FOPQ-C-SF and mBPI for young people with cerebral palsy. Future research will examine the comprehensibility of the adapted tools across the population.
PMID: 40575731

17.The Mental Health of Children with Cerebral Palsy: A Review of the Last Five Years of Research

Rebecca Rausch, Summer Chahin, Caroline Miller, Lindsey Dopheide, Nicholas Bovio, Ann Harris, Dilip Patel

Review J Clin Med . 2025 Jun 19;14(12):4364. doi: 10.3390/jcm14124364.

Background/objectives: Children and adolescents with cerebral palsy (CP) often experience associated functional limitations, diseases, or impairments. Included in these associated concerns are mental health symptoms/disorders and academic concerns. There has been an increasing research focus on the mental health of youth with CP over the past 5 years, and there is a need to synthesize this research. This review aims to synthesize the most recent research on the mental and behavioral health of youth with CP.
Methods: A literature search on research focused on mental health, academic functioning, and mental and behavioral treatment for youth with CP was conducted in August of 2024 and limited to the last 5 years to highlight the most recent developments in this area of research. Four hundred and forty-eight articles were screened, and thirty-eight articles were included in this review.
Results: Based on this literature review, children with CP have high rates of mental health diagnoses across multiple diagnostic areas, including autism spectrum disorder, attention-deficit hyperactivity disorder, intellectual developmental disorder, anxiety, and depression. Academic concerns are common for children with CP. Intervention studies have focused on both child and parent interventions.
Conclusions: Research over the past 5 years has added to prevalence estimates of mental health disorders in the pediatric CP population. Considering the high rates of mental health symptoms found in children with CP, future research should focus further on mental health interventions for this population.
PMID: 40566110

18.Assessing malnutrition in cerebral palsy patients and its impact on complications following spinal fusion

Haseeb E Goheer, Phillip T Yang, Yasmine S Ghattas, Gabriel Ramirez, Ram Haddas, Andrew G Dubina, Susan E Nelson, Varun Puvanesarajah

Spine Deform . 2025 Jun 23. doi: 10.1007/s43390-025-01129-5. Online ahead of print.

Background: Cerebral palsy (CP) patients with severe scoliosis are frequently malnourished. However, there is a paucity of literature focusing on the impact of pediatric malnutrition indicators on post-operative surgical complications. This study aims to examine the relationship between measures of nutritional status and their ability to predict post-operative complications in patients with CP undergoing spinal fusion for neuromuscular scoliosis.
Methods: The American College of Surgeons National Surgical Quality Improvement Program Pediatric was queried retrospectively to identify pediatric CP patients who had undergone spinal fusions for neuromuscular scoliosis between 2016 and 2022 using the Current Procedural Terminology Code 22804. Univariate and multivariate regression were employed to assess differences in preoperative patient characteristics as well as postoperative complications across malnutrition definitions (stunting, wasting, and requiring nutritional support).
Results: A total of 2017 patients were identified between 2016 and 2022, of which 1124 received nutritional support and 893 did not. Among all patients, 93.3% (n = 1882) met at least one definition of malnutrition, 58.1% (n = 1172) met two or more definitions, and 9.3% (n = 187) met all three definitions of malnutrition. After adjustment, requiring nutritional support independently increased the risk for an extended intensive care unit stay (OR:1.35; 95 CI [1.01-1.83]; p = 0.047). Wasting independently increased the risk for unplanned intubation (OR:1.77; 95 CI [1.02-3.02]; p = 0.038) while stunting increased the risk for deep/organ space surgical site infection (OR:2.50; 95 CI [1.20-6.10]; p = 0.025).
Conclusion: Patients with malnutrition (defined as nutritional support) are at increased risk for an extended intensive unit care stay in the postoperative period. Personalized postoperative management with multidisciplinary teams, guided by risk assessment, may help mitigate postoperative complications and address the challenges associated with malnutrition.
PMID: 40549280

19.Inspiratory Muscle Training in Adults With Cerebral Palsy: Long Term Effects: A Double-Blind Randomized, Controlled Trial

Carlos Martin-Sanchez, Fausto Jose Barbero-Iglesias, Victor Amor-Esteban, Marta Martin-Sanchez, Ana Maria Martin-Nogueras

Res Nurs Health . 2025 Jun 20. doi: 10.1002/nur.70000. Online ahead of print.

Abstract
Respiratory disease is one of the main causes of morbidity and mortality in adults with cerebral palsy (CP). The main objective of the study was to investigate the maintenance over time of improvements in respiratory parameters achieved with inspiratory muscle training (IMT). This was a randomized, controlled, double-blind trial and with allocation concealment performed on 27 institutionalized CP patients randomly distributed in two groups: "high intensity training group" (HIT) trained with a load of 40% of the maximum inspiratory pressure (MIP) and "low intensity training group" (LIT) with 20%. Respiratory strength and pulmonary function were evaluated throughout the study. Four weeks after IMT most improvements persisted. Twelve weeks after IMT, only HIT maintained significant improvements ($p = 0.001$) in MIP; 24 weeks after IMT, in the HIT group, MIP was 10% higher than the initial results and pulmonary function parameters were 1% lower. In the LIT group, respiratory strength and pulmonary function were lower than at baseline. Improvements achieved with IMT are reduced over time once the treatment ends. During the first 4 weeks posttreatment, the benefits persist but from the 12th week there was a progressive loss of the improvement reaching a total loss at 24 weeks. To be most effective, a higher MIP load is suggested for respiratory treatment, which must be maintained over time and interruptions should not be longer than 4 weeks. Clinical trial registration. The study was registered in the clinical trials database of the United States National Library of Medicine (www.clinicaltrials.gov) with the number of registration NCT04915170.
PMID: 40539466

20.Multi-center improvement in screening for pain that affects activities in adults with cerebral palsy

Amy F Bailes, Garey H Noritz, Duncan O Wyeth, Elizabeth J Lucas, Elisabeth B Bates, Hana Azizi, Cristina A Sarmiento, Deborah E Thorpe, Stephen A Nichols, Jodi Kreschmer, Stephen Wisniewski, Mary Gannotti

Disabil Health J . 2025 Jun 12:101911. doi: 10.1016/j.dhjo.2025.101911. Online ahead of print.

Background: Descriptions of how centers implement standardized screening for pain and how pain affects activities among adults with cerebral palsy (CP) are lacking.
Objective: Improve screening for pain in adults with CP across three centers and examine factors associated with pain that affect activities.
Methods: Using the quality improvement (QI) infrastructure of the Cerebral Palsy Research Network (CPRN), we implemented interventions to improve screening at clinic visits for pain that affects activities for adults with CP. Four physicians from three CPRN centers in the United States performed interventions. To track progress, we collected visit data cross sectionally every two weeks. Descriptive statistics, analysis of variance, and logistic regression evaluated relationships in a cohort of visits after screening practices had been established.
Results: Screening improved from 42 % at baseline to over 90 %. After three months of sustained screening, we assessed 423 visits. Pain was reported at 185/423 (44 %) of visits. 100/185 (54 %) reported pain that affected activities. Increasing age, female gender, and greater motor function were associated with pain ($p < 0.001$) and pain that affects activities ($p < 0.01$). Females reported pain 3.4 times and pain that affects activity 2.2 times more than males.
Conclusion: QI methodology was successful at improving screening for pain that affects activities in adults with CP. Lower rates of pain were found (44 %) than previous reports, with similar findings about pain affecting activities and associated characteristics. Next steps should include continued screening with improvement in differentiating proxy vs self-report and including other domains of pain important to guide care.
PMID: 40537398

21.How a Microfinance-Based Livelihood Program can Combat Food Insecurity Among Families of Children With Cerebral Palsy in Bangladesh-Evidence From a Randomized Control Trial

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Food Nutr Bull . 2025 Jun 19:3795721251348338. doi: 10.1177/03795721251348338. Online ahead of print.

Abstract
Background Household food insecurity is a critical concern for ultra-poor families in low- and middle-income countries like Bangladesh, particularly those with members who have disabilities. The COVID-19 pandemic has worsened this situation. Objective This study aimed to assess the impact of microfinance-based livelihood programs on food insecurity in ultra-poor families with members affected by cerebral palsy in Bangladesh. Methods Data were extracted from the SUPPORT CP trial for 251 children with cerebral palsy. The Household Food Insecurity Access Scale score was the outcome variable. The explanatory variable was the intervention type, dividing the sample into 3 arms: Arm C (care as usual), Arm B (Community-Based Rehabilitation [CBR]), and Arm A (CBR with the integrated microfinance-based livelihood program [IMCBR]). Both linear regression and the Generalized Estimating Equations model were used to determine the association of outcome variable with explanatory variables adjusting for covariates. Results We found a consistent level of household food insecurity across each time point, with a significant increase in the midline during the peak of COVID-19 pandemic in 2020. However, following the end of the COVID-19 pandemic, both Arms A and B, where interventions were provided, reported a significant decline in food insecurity. Notably, Arm A, where IMCBR was provided, exhibited the fastest decrease in food insecurity followed by Arm B, where only CBR was provided, compared to Arm C .Conclusion Microfinance programs can reduce food insecurity among families of children with cerebral palsy in Bangladesh, especially during crises like COVID-19, underscoring the need to integrate them with tailored disability rehabilitation services.
Plain language summary
How Microfinance Can Help Families with Disabilities in Bangladesh Reduce Hunger.
PMID: 40534419

22.Clinician perspectives on implementing the C-BiLLT-CAN for non-speaking children with cerebral palsy: a focus group study

Juno Coan-Brill, Frances Aileen Costigan, Tom Chau, Johanna Geytenbeek, Kristine Stadskleiv, Beata Batorowicz, Jessica Kay, Sarah Hopmans, Danijela Grahovac, Barbara Jane Cunningham

Disabil Rehabil . 2025 Jun 23:1-17. doi: 10.1080/09638288.2025.2520998. Online ahead of print.

Abstract
Purpose: Currently available methods may not reliably assess language comprehension in children with significant speech and motor limitations. The Computer-Based instrument for Low motor Language Testing (C-BiLLT) is a standardized assessment designed for children with cerebral palsy that allows them to participate using various alternative response methods. This study aimed to understand speech-language pathologists' and occupational therapists' perceived facilitators and barriers to implementing the Canadian C-BiLLT (C-BiLLT-CAN).
Materials and methods: Six focus groups were conducted with 30 clinicians. Transcripts were analyzed using a semi-deductive thematic analysis. The Consolidated Framework for Implementation Research was used to guide the identification of clinicians' perceived facilitators and barriers.
Results: Clinicians unanimously reported interest in implementing the C-BiLLT-CAN. Facilitators and barriers were classified into five primary themes. Key facilitators related to the test's evidence-based design, standardized nature, and potential flexibility. Key barriers related to Internet connectivity, the need to expand customization and response options to meet a greater breadth of needs, privacy policies, lack of resources, and perceived costs associated with equipment, training, and time.
Conclusions: Many perceived barriers aligned with previous European and Canadian C-BiLLT implementation research. However, findings elucidated unique considerations that will inform adaptations to the C-BiLLT-CAN and development of training/educational materials.
Plain language summary
Clinicians unanimously expressed interest in implementing the C-BiLLT-CAN in their clinical practice with children with limited functional speech and motor skills Facilitators to implementing the C-BiLLT-CAN related to its evidence-based design, standardized nature, and potential flexibility Key barriers related to Internet connectivity, the need to expand customization and response options to meet a greater breadth of needs, privacy policies, lack of resources, and potential costs Findings will inform an adapted C-BiLLT-CAN to facilitate clinical implementation, as well as training and educational materials to support implementation.
PMID: 40548527

23.Does instrumentation have an effect on the outcome of a bimanual performance assessment in children with cerebral palsy?

Julie Rozaire, Audrey Combey, Alexandre Naaim, Sonia Duprey, Emmanuelle Chaleat-Valayer, Rachel Bard-Pondarré

Res Dev Disabil . 2025 Jun 18:164:105057. doi: 10.1016/j.ridd.2025.105057. Online ahead of print.

Background: In the majority of instrumented assessments of upper limb function, participants are frequently required to complete tasks in a standardised manner in order to facilitate inter-participant comparisons. However, this approach may result in the loss of valuable information regarding the patient's performance in everyday life. The instrumented performance assessment of the Assisting Hand Assessment (AHA) could yield meaningful information about the patient's spontaneous use of the impaired limb. This study aims to determine if the presence of a motion analysis setting impacts AHA scores in children with unilateral cerebral palsy.
Methods: Eighteen children (18 months-13 years) underwent regular and instrumented AHA sessions (7 Vicon cameras, 17 markers). The ratings of the AHAs were randomly divided for each participant between two occupational therapists. Descriptive statistics were employed, including a Bland-Altman plot with a clinical difference threshold of at least 5 points out of 100. Additionally, paired Student's t-tests or Wilcoxon tests were conducted based on data normality.
Results: Inter-rater reliability for the AHA was high (maximum difference of 2 out of 80 points). No significant differences were found between instrumented and regular AHA scores, and no correlation with the age.
Conclusions: This study demonstrates the feasibility of integrating motion capture into the AHA without compromising its reliability, regardless of the participants' age. Future research should focus on developing methods for reliably quantifying movement parameters within the AHA framework.
PMID: 40554084

24.Development and Validation of a Virtual Version of the Box and Block Test to Assess Manual Dexterity at Home for Adults with Stroke and Children with Cerebral Palsy

Zélie Rosselli, Merlin Somville, Edouard Ducoffre, Carlyne Arnould, Geoffroy Saussez, Yannick Bleyenheuft

Bioengineering (Basel) . 2025 Jun 16;12(6):662. doi: 10.3390/bioengineering12060662.

Abstract
The REAtouch® Lite device was recently developed to support motor skill learning-based interventions, integrating both games/activities and assessment tools to enable home-based telerehabilitation. Given the importance of hand functions in rehabilitation of patients with brain lesions, this study aimed to validate a virtual version of the Box and Block Test (vBBT) implemented in the REAtouch® device. A total of 205 healthy participants, 37 post-stroke adults, and 37 children with cerebral palsy (CP) performed the standard BBT, various versions of the newly designed vBBT (with/without a separation wall; with 6, 4, and free zones) and the Tower of London test assessing executive function/planning abilities. Friedman's ANOVA revealed significant differences between the BBT and all versions of the vBBT scores in healthy participants (all $p < 0.001$). However, the vBBT-4 zones showed the largest intraclass correlation coefficient (ICC) with the BBT in healthy participants (0.58) and even higher correlations in participants with CP and stroke (>0.8). Only the vBBT-6 zones version showed a significant correlation with patients' planning abilities ($p < 0.01$; $r = -0.28$). These findings highlight the vBBT-4 zones as the most relevant version to assess hand dexterity directly with the REAtouch® device, potentially within telerehabilitation modalities. Further normative data must be established.
PMID: 40564478

25.Design of a mobile application based on artificial intelligence to identify pain in non-communicating individuals with cerebral palsy

Álvaro Sabater-Gárriz, F Xavier Gaya-Morey, José María Buades-Rubio, Cristina Manresa-Yee, Inmaculada Riquelme, Pedro Montoya, Pau Martínez-Bueso

Res Dev Disabil . 2025 Jun 18:164:105058. doi: 10.1016/j.ridd.2025.105058. Online ahead of print.

Introduction: Pain assessment in individuals with cerebral palsy (CP), particularly those unable to self-report, is a significant challenge. Pain is the most common comorbidity in CP, yet current evaluation methods are often subjective and unreliable. An AI-based facial recognition system integrated into a mobile application could provide an objective, reliable tool for pain assessment in this population.
Objectives: METHODS: Three approaches were employed: RESULTS: A systematic review identified seven studies on automated facial recognition systems for pain detection. However, only one of these systems-ePAT/PainCheck-has been developed into a functional mobile application for clinical use, though not specific to individuals with cerebral palsy. This underscores the novelty of the current initiative. The feasibility of our proposed app was confirmed, and key technical and functional requirements were outlined, including intuitive design, dual local/cloud processing, and mechanisms for system improvement. Stakeholders emphasized ease of use, and suggested incorporating features such as accuracy estimation, offline functionality, multi-language support, and open communication fields.
Conclusions: This novel and feasible app represents a significant advance in pain assessment for CP, with potential applications in other neurological conditions with communication impairments and unique facial expressions.
PMID: 40554083

26.A space-gamified approach to examine muscle contraction behaviour in children and adolescents with spastic cerebral palsy: feasibility, acceptability and repeatbility

Jule Heieis, Ibrahim Duran, Eckhard Schönau, Christoph Fritzsche, Bettina Götz, Laura Kehe, Moritz Meier, Karoline Spiess, Wilhelm Bloch, Jörn Rittweger

Front Pediatr . 2025 Jun 5:13:1520162. doi: 10.3389/fped.2025.1520162. eCollection 2025.

Introduction: Cerebral palsy (CP) is the most common disease affecting mobility among children. However, relatively little is known about the muscle phenotype and the resulting impairments in muscle function of this population. We therefore examined feasibility and acceptability of a muscle testing protocol that is based on the muscle examinations of astronauts and in bed-rest studies in children and adolescents with CP (clinical trial registry number DRKS00031107).
Methods: Twelve participants, aged between 8 and 18 years, with CP and age-matched able-bodied counterparts (Ctrl) have been included to the study. They completed testing procedures on two visits. Participants performed isometric maximum voluntary contractions, step and ramp contractions in plantarflexion on a custom build dynamometer. The tasks were visualized using a torque-controlled video game. We computed steadiness, defined as standard deviation of the fluctuations, and slope, as well as the achieved MVC. Data were statistically analyzed via Intraclass correlation coefficient (ICC) for between-visit analysis and Mann-Whitney U test for between-group analysis.
Results: One participant of the CP group was not able to perform the tasks and dropped out for the second visit. Especially younger children and children with cognitive impairments were not able to adequately answer the acceptance questionnaire. The MVC of Ctrl was higher in both visits and was excellently repeatable. During step contractions Ctrl showed lower fluctuations in both visits. Also, during ascending ramp contractions Ctrl showed less fluctuations but only at visit 1. During descending ramp contractions steadiness was better in Ctrl at both visits. Performance parameters were all poorly repeatable, because the CP group improved their performance in all tasks at visit 2.
Discussion: Application of our gamified muscle testing protocol was well acceptable and mostly feasible. Contrasting with constant isometric contractions and decreasing ramp contractions, the performance of children with CP during ascending ramp contractions improved to the level of control subjects within 2 visits. A crucial prerequisite to perform successful measurements are good cognitive skills and at least one familiarization visit.
Clinical trial registration: https://www.drks.de/DRKS00031107, identifier (DRKS00031107).
PMID: 40538926

27.Iron Deficiency Prevalence in Bulgarian Children with Cerebral Palsy and Autism: A Call for Nutritional Interventions to Support Development

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Nutrients . 2025 Jun 10;17(12):1969. doi: 10.3390/nu17121969.

Abstract
Background/Objectives: Iron plays an important role in cognitive, behavioral, and motor development. This study aims to assess the iron nutritional status of Bulgarian children with cerebral palsy (CP) and autism spectrum disorder (ASD), focusing on iron deficiency (ID) and its impact on children's development. We hypothesized that children with CP and ASD suffer from iron deficiency. Methods: The cross-sectional study includes 95 children from northeastern Bulgaria. Data were collected in two periods (2017-2018 and 2023-2024). Demographic questionnaires, food frequency questionnaires, and laboratory tests for hemoglobin, serum iron, serum ferritin, serum albumin, and CRP were conducted. Anthropometric measurements were evaluated. The Gross Motor Function Classification System scale was used to assess motor function in children with CP. Statistical analysis was performed using Jamovi software, ver. 2.6.44, with a significance level of $p < 0.05$. Results: Of the 95 children, 62.1% had CP and 37.9% had ASD. Most children had normal hemoglobin and serum iron levels, but 62.7% of those with CP and 36.8% of those with ASD had low serum ferritin levels, indicating latent ID. A higher proportion of children with CP than those with ASD consumed meat daily, while fish was more commonly consumed by children with ASD. Anthropometric data showed delayed growth and lower height-for-age scores in children with CP. Conclusions: The study identifies latent ID in children with CP and ASD. An evaluation of dietary habits highlights the need for interventions to improve nutritional status and development. The observed deficiencies emphasize the need for regular monitoring and targeted dietary programs for children in these groups.
PMID: 40573080

28.Understanding the Parental Caregiving of Children with Cerebral Palsy in Saudi Arabia: Discovering the Untold Story

Ashwaq Alqahtani, Ahmad Sahely, Heather M Aldersey, Marcia Finlayson, Danielle Macdonald, Afolasade Fakolade

Int J Environ Res Public Health . 2025 Jun 17;22(6):946. doi: 10.3390/ijerph22060946.

Abstract
Parents provide most of the support needed for children with cerebral palsy (CP) to increase the child's participation and independence. Understanding the experiences of parents caring for children with CP is essential for developing effective family programs and services. The current knowledge about parents' experiences in CP is based on studies in Western countries, with little known about this phenomenon in Arab countries like Saudi Arabia. This study aimed to understand the unique experiences and support needs of Saudi parents caring for children with CP from a social-ecological perspective. We conducted a qualitative, exploratory, descriptive study involving 12 semi-structured interviews with mothers and fathers of children with different types of CP. We analyzed the data using a reflexive thematic approach, following six distinct phases. Participants' narratives revealed a complex caregiving journey marked by both challenges and rewards. Support from Saudi nuclear and extended family members was considered important; however, many parents expressed a need for additional physical and financial assistance from their families. Parents reported feeling stressed and experiencing challenges in accessing and navigating educational and healthcare services. Our findings highlight that Islamic values play a crucial role in the experiences of Saudi parents. These values foster a sense of collectivism, highlighting the importance of family support and community involvement, which can affect the Saudi caregiving environment. Parents remain an essential yet often invisible part of the Saudi caregiving system. Without adequate support, parents are at risk of experiencing social, financial, academic, physical, and mental health challenges, which may affect their overall family well-being. Future work may need to consider spiritual and gender roles when developing programs or services to support Saudi parents of children with CP.
PMID: 40566372

29.School-based mental health and psychosocial support interventions for children and adolescents with developmental disabilities in low- and middle-income countries: A systematic review

Maria Jose Alpuche De Lille, Renata da Teixeira da Silva, Tracey Smythe

Review Trop Med Int Health . 2025 Jun 24. doi: 10.1111/tmi.70000. Online ahead of print.

Objectives: To identify and evaluate the characteristics and reported effects of school-based mental health and psychosocial support interventions targeting children and adolescents with neurodevelopmental disorders (NDDs) in low- and middle-income countries, as well as those involving their parents, teachers or peers.
Methods: A systematic search of MEDLINE, EMBASE, ERIC, Global Health and PsycINFO was conducted in October 2024. Eligible studies included randomised controlled trials, quasi-experimental and qualitative research on school-based interventions in low- and middle-income countries for children and adolescents with NDDs (including attention deficit hyperactivity disorder [ADHD], autism, intellectual disabilities, epilepsy, cerebral palsy and foetal alcohol syndrome), as well as those involving their caregivers, teachers or peers. Only studies published in English, Spanish or Portuguese were included. A narrative synthesis was performed.
Results: A total of 2158 titles were screened, with 29 studies from 13 countries included. Most studies used a quasi-experimental design (n = 19, 66%). Nearly half focused on children and adolescents with NDDs only (n = 14, 48%), with intellectual disabilities being the most targeted condition (n = 12, 34%), followed by autism (n = 8, 23%) and ADHD (n = 8, 23%). Intervention strategies included multimodal approaches (n = 6, 21%) and educational workshops (n = 6, 21%). Targeted outcomes were social skills (n = 7, 16%) and knowledge attitudes and practice (n = 5, 12%). Lifelong learning (n = 11, 33%) and educational system-strengthening interventions (n = 10, 31%) were the primary content areas. The majority of studies exhibited a moderate to high risk of bias.
Conclusions: Schools offer strategic platforms for delivering mental health and psychosocial support interventions to children and adolescents with NDDs in low- and middle-income countries, involving families, teachers and peers. While improvements in social skills and knowledge, attitudes and practices were reported, heterogeneity and methodological limitations constrain the generalisability of findings. Future research should address long-term impacts and expand to underrepresented conditions.
PMID: 40556074

30.Neuroimaging to Genetics: Unraveling the Etiology of Cerebral Palsy in Children From Southern Brazil

Daniel Almeida Do Valle, Gabriel Dias Gomes, Giovanna Massignan Coppla, Isadora Finger Mascarello, Karen Almeida Camargo, Kawanna Izabella Buzzo Feitosa, Sophia Oliveira Basso, Elisabete Coelho Auersvald

J Child Neurol . 2025 Jun 19:8830738251346918. doi: 10.1177/08830738251346918. Online ahead of print.

Abstract
This retrospective observational study investigates the clinical and neuroimaging profiles of children with cerebral palsy and explores the contribution of genetic factors to its etiology. We reviewed 302 pediatric cases diagnosed with cerebral palsy in Southern Brazil during 2023. Neuroimaging abnormalities were present in 92.1% of cases, with leukomalacia being most frequent. Neonatal encephalopathy emerged as the leading etiology, followed by prematurity and genetic conditions. Genetic testing was performed in 68 patients, identifying 29 distinct genes, notably in cases with preserved imaging or kernicterus. Dyskinetic and ataxic cerebral palsy were more often associated with normal neuroimaging, although not necessarily with positive genetic findings. Some patients with kernicterus also had genetic etiology, especially G6PD. The study reinforces that normal imaging does not exclude underlying genetic causes, especially in patients lacking perinatal complications or exhibiting dyskinetic patterns. These findings emphasize the complementary roles of neuroimaging and genetic in the multifactorial nature of cerebral palsy.
PMID: 40534433

31.Lesion distribution and network mapping in dyskinetic cerebral palsy

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Brain Commun . 2025 Jun 13;7(3):fcaf228. doi: 10.1093/braincomms/fcaf228. eCollection 2025.

Abstract
Dyskinetic cerebral palsy encompasses a group of predominantly perinatally acquired complex motor disorders that present with dystonia and/or choreoathetosis and are frequently associated with brain lesions in neuroimaging. Recently, lesion network mapping provided a tool to redefine neurological disorders as circuitopathies. Elucidating the common networks impacted by lesions in this condition could pave the way to identify new targets for neuromodulatory therapeutic approaches. In this study, we aim to assess lesion distribution in dyskinetic cerebral palsy and identify a related functional network derived from lesions. Here, we review the literature of MRI findings in dyskinetic cerebral palsy and perform literature-based lesion network mapping. Articles reporting conventional MRI findings clearly attributable to affected patients were included for review. Imaging findings and their anatomical distribution were extracted and quantified according to an established MRI classification system for cerebral palsy. Reviewed articles were searched for figures depicting lesions and these were traced onto a paediatric template. Whole-brain functional connectivity from lesions causing dyskinetic cerebral palsy was calculated using a paediatric resting-state functional MRI connectome. Individual maps were thresholded and later overlapped to derive a common network map associated with dyskinetic cerebral palsy. Results were contrasted with two control datasets for spatial specificity. Review of 48 selected articles revealed that grey matter injury predominated (51%), followed by white matter injury (28%). In 16% of cases MRI was normal. Subcortical lesions affected the thalamus, pallidum and putamen in >40% of reported patients, respectively. Figures available from 23 literature cases were used to calculate the lesion netwok map of dyskinetic cerebral palsy. The lesion-derived map revealed functional connectivity to a wide network including the brainstem, cerebellum, basal ganglia, cingulate and sensorimotor cortices. The strongest connectivity was found for the motor thalamus. This study confirms subcortical grey matter lesions as the most common MRI finding in dyskinetic cerebral palsy. The neural network identified with lesion network mapping includes areas previously implicated in hyperkinetic disorders and highlights the motor thalamus as a common network node. These results should be validated and their therapeutic implications explored in prospective trials.
PMID: 40574970

32.Construct Validity and Internal Consistency of the Italian Version of the PedsQLTM 4.0 Generic Core Scale and PedsQLTM 3.0 Cerebral Palsy Module

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Children (Basel) . 2025 Jun 9;12(6):749. doi: 10.3390/children12060749.

Background: Health-related quality of life (HRQoL) has emerged as a meaningful outcome measure in clinical trials and healthcare interventions in children with cerebral palsy (CwCP). We assessed the construct validity and internal consistency of the Italian version of the Paediatric QoL inventory (PedsQLTM) 4.0 Generic Core Scales (GCS) and PedsQLTM 3.0 Cerebral Palsy Module (CPM).
Methods: A total of 125 CwCP and their parents were enrolled. Participants completed both the GCS and the CPM modules, and the results were compared to those of a sample of 121 healthy peers and their parents. The dimensionality of the two modules was assessed through exploratory factor analysis. Construct validity was assessed by a known-groups method evaluating the differences between CwCP and healthy sample.
Results: Only a few GCS subscales were unidimensional, while all CPM subscales proved to be unidimensional, except for the Speech and Communication subscales of child self-reports. GCS internal consistency was good for all subscales of the parent proxy-reports, as well as for the Physical Activities and Psychosocial Health subscales of child self-reports. CPM internal consistency was good for both parent proxy-reports and-with a few exceptions-child self-reports. As for the PedsQLTM validity, the GCS proved effective in discriminating between CwCP and healthy participants; the CPM showed a significant association between lower neurofunctional abilities and lower HRQoL. Parent-child concordance shows that child self-report scores were always higher than the those of the proxy-reports for both the GCS and CPM modules.
Conclusions: The present study confirms the internal consistency and construct validity of the Italian version of both PedsQLTM modules. In CwCP, greater functional disability resulted in lower HRQoL scores, and there was significant discrepancy between the parent and child ratings.
PMID: 40564708

33.Longitudinal observational research study: establishing the Australasian Congenital Cytomegalovirus Register (ACMVR)

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Observational Study BMJ Open . 2025 Jun 25;15(6):e095636. doi: 10.1136/bmjopen-2024-095636.

Purpose: Congenital cytomegalovirus (cCMV) is an important cause of long-term childhood disability. In Australia, the identification and treatment practices and the long-term clinical and neurodevelopmental outcomes of children with cCMV are unknown. The Australasian cCMV Register (ACMVR) is a longitudinal register and resource for research that aims to describe and explore, in Australian children with cCMV: (1) their clinical characteristics over time, (2) antiviral therapy use/prescribing up to 1 year of age and (3) risk factors and potential avenues for prevention of adverse sequelae of the virus.
Participants: Children <18 years, with confirmed or probable cCMV infection, identified via medical records, community referral and physician referrals, in states with active study sites, are eligible for inclusion. The consent process is site-specific, reflecting local requirements and including both explicit consent and opt-out models. Participation in the ACMVR allows local site researchers to (1) collect specified demographic and clinical data from medical records, health professionals and families, (2) recontact parents/guardians to undertake developmental screening for their child at time-points up to 5 years of age, (3) share information with parents/guardians about relevant ethically approved research studies and (4) include participant data in ethically approved data linkage studies.
Findings to date: Ethics and governance approvals, study database and a steering group have been established. Data collection is active in five sites across Australia.
Future plans: The ACMVR will inform our understanding of the long-term outcomes for children with cCMV in Australia and provide a sampling frame and resource for recruitment in future clinical and epidemiological research to inform practice and policy. New opportunities for the establishment of additional study sites and collaborations with Australian maternity and fetal medicine researchers and with cCMV registries in other countries are currently being explored.
PMID: 40562547

34.Cerebral palsy

Iona Novak, Michelle Jackman, Megan Finch-Edmondson, Michael Fahey

Review Lancet . 2025 Jun 20:S0140-6736(25)00686-5. doi: 10.1016/S0140-6736(25)00686-5. Online ahead of print.

Abstract
Cerebral palsy is a lifelong physical disability affecting movement and posture. The motor impairments of cerebral palsy result from non-degenerative brain injuries, brain malformations, and genetic variations, arising from multiple risk factors and causal pathways during preconception, pregnancy, birth, or within the first 2 years of life. Over the past decade, substantial progress in diagnosing, preventing, and managing the condition has transformed treatment approaches. A key discovery is that up to 30% of individuals with CP have a genetic contribution. In high-income countries, the prevalence has decreased by as much as 40%, from 2·1 per 1000 livebirths to 1·6 per 1000 livebirths. However, the prevalence is higher in low-income and middle-income countries. Advances in early diagnosis make identification of cerebral palsy at as early as age 3 months possible, enabling timely, intensive early intervention that improves child and parent outcomes. Additionally, new medical, regenerative, and rehabilitation therapies have emerged, enhancing function and participation. Growing awareness of the health challenges and physical decline faced by adults underscores the need for a lifelong approach. This Seminar highlights the best available evidence and recent progress to help clinicians address key questions identified by individuals with lived experience.
PMID: 40550230

35.Development and Validation of a Stakeholder-Driven, Self-Contained Electronic Informed Consent Platform for Trio-Based Genomic Research Studies

Bethany Y Norton, James Liu, Sara A Lewis, Helen Magee, Tyler N Kruer, Rachael Dinh, Somayeh Bakhtiari, Sandra H Nordlie, Sheetal Shetty, Jennifer Heim, Yumi Nishiyama, Jorge Arango, Darcy Johnson, Lee Seabrooke, Mitchell Shub, Robert Rosenberg, Michele Shusterman, Stephen Wisniewski, Blair Cooper, Erin Rothwell, Michael C Fahey, M Wade Shrader, Nancy Lennon, Joyce Oleszek, Wendy Pierce, Hannah Fleming, Mohan Belthur, Jennifer Tinto, Garey Noritz, Laurie Glader, Kelsey Steffen, William Walker, Deborah Grenard, Bhooma Aravamuthan, Kristie Bjornson, Malin Joseph, Paul Gross, Michael C Kruer

AJOB Empir Bioeth . 2025 Jun 23:1-12. doi: 10.1080/23294515.2025.2497756. Online ahead of print.

Abstract
Background: Increasingly long and complex informed consents have yielded studies demonstrating comparatively low participant understanding and satisfaction with traditional face-to-face approaches. In parallel, interest in electronic consents for clinical and research genomics has steadily increased, yet limited data are available for trio-based genomic discovery studies. We describe the design, development, implementation, and validation of an electronic iConsent application for trio-based genomic research deployed to support genomic studies of cerebral palsy.
Methods: iConsent development incorporated stakeholder perspectives including researchers, patient advocates, institutional review board members, and genomic data-sharing considerations. The iConsent platform integrated principles derived from prior electronic consenting research and elements of multimedia learning theory. Participant understanding was assessed in an interactive teachback format. The iConsent application achieved nine of ten proposed desiderata for effective patient-focused electronic consenting for genomic research.
Results: Overall, participants demonstrated high understanding and retention of key human subjects considerations. Enrollees reported high levels of satisfaction with the iConsent, and we found that participant understanding, iConsent clarity, privacy protections, and study goal explanations were associated with overall satisfaction.
Conclusions: Although opportunities exist to optimize iConsent, we show that such an approach is feasible, can satisfy multiple stakeholder requirements, and can realize high participant satisfaction and understanding while increasing study reach.
PMID: 40549577

36.Parenting Acceptance and Commitment Therapy Online (PACT Online) for parents of children diagnosed with or with increased likelihood of neurodevelopmental disability: study protocol of a randomised controlled trial

Koa Whittingham, Grace Kirby, Roslyn N Boyd, Iona Novak, Amy E Mitchell, Natasha Reid, Syed Afroz Keramat, Kristelle Hudry, Josephine Barbaro, Jacqui Barfoot, Robert S Ware, Fiona Russo, Helen Heussler, Andrea McGlade, Ashleigh Bullot, Megan MacDonald, Tommy Tran, Sophie Harrington, Jeanie Sheffield, Rebecca Olson, Nathalia Costa

BMJ Open . 2025 Jun 20;15(6):e088981. doi: 10.1136/bmjopen-2024-088981.

Introduction: Approximately 1 in 13 Australian children have a neurodevelopmental disability. This project aims to assess the effectiveness and implementation of an online parenting support programme, Parenting Acceptance and Commitment Therapy (PACT) Online, for parents of children with neurodevelopmental disabilities for improving the parent-child relationship and parent and child outcomes.
Methods and analysis: This hybrid type 1 randomised controlled trial will focus on evaluating intervention effectiveness and understanding the context for implementation. The primary outcome is observed emotional availability within parent-child interactions assessed at postintervention (12 weeks postbaseline) with additional measurement at follow-up (6 months postbaseline). Secondary outcomes include (1) parent-reported emotional availability, (2) parental mindfulness, (3) parent mental health, (4) psychological flexibility, (5) adjustment to child's disability, (6) health behaviour and (7) regulatory abilities as well as child outcomes of (1) mental health, (2) adaptive behaviour and (3) regulatory abilities. Evaluation of implementation will include an economic evaluation of costs and consequences, and an implementation analysis grounded in the consolidated framework for implementation research with a focus on contextual factors influencing implementation.
Ethics and dissemination: Ethical approval has been obtained from the University of Queensland Human Research Ethics Committee (023/HE000040). Dissemination of study outcomes will occur through the appropriate scientific channels. Long-term implementation will be grounded within the implementation analysis and occur in partnership with the partner organisations and consumer engagement panel. This will include releasing the PACT Online intervention as a massive open online course on the edX platform if support for intervention effectiveness and implementation is found.
Trial registration number: ACTRN12623000612617; this trial has been registered with the Australian New Zealand Clinical Trials Registry.
PMID: 40541441

37.Understanding medical students' knowledge and attitudes about cerebral palsy

Brianna Callahan, Andrea Janis, Swetha Reddi, Andrew S Nowak, Ronald Thomas, Karin Przyklenk, Christina Santia, Charles Pelshaw

PM R . 2025 Jun 19. doi: 10.1002/pmrj.13420. Online ahead of print.

Background: Children with cerebral palsy and other disabilities face barriers in obtaining equitable medical care. Although many factors contribute to these disparities, physicians' lack of knowledge and comfort when caring for patients with cerebral palsy have been reported to play a role. We propose that this gap in understanding may reflect a deficit in disability education during medical school.
Objective: To (1) obtain insight into medical students' knowledge regarding cerebral palsy at two medical schools in the United States; and (2) determine whether viewing a brief educational video increases short-term knowledge regarding cerebral palsy.
Methods: All medical students attending Wayne State University School of Medicine and Central Michigan University College of Medicine in November-December 2023 were invited to participate in the study. Respondents completed a three-step survey, in which they answered nine multiple-choice knowledge-based questions about cerebral palsy, viewed a 10-minute educational video, and responded to the same nine knowledge-based questions after viewing the video.
Results: A total of 221 surveys were received (response rate: 14%). For the submitted surveys in which paired data were available, the percentage of correct responses at baseline (previdео), averaged for the nine knowledge-based questions, was 45 ± 15% and increased to 67 ± 11% after viewing the educational video ($p < .01$).
Conclusions: Our results reveal that medical students' knowledge of cerebral palsy is limited and that a brief, focused educational session may have a short-term beneficial effect in mitigating this gap in knowledge.
PMID: 40538046

38.A qualitative study of the social and emotional needs of adults with cerebral palsy: "it's a terrible gap"

Christine L Petranovich, Cristina A Sarmiento, Chloe Glaros, Hannah Friedman, Lisa A Brenner, Brooke Dorsey Holliman

Disabil Rehabil . 2025 Jun 19:1-8. doi: 10.1080/09638288.2025.2520286. Online ahead of print.

Purpose: We aim to explore the social and emotional needs of adults with cerebral palsy (CP) and their caregivers.
Methods: This qualitative descriptive study included adults with CP between the ages of 20-37 and their caregivers. We conducted 21 semi-structured interviews (7 interviews with adults with CP, 9 with only the caregiver of an adult with CP, and 5 dyads of an adult with CP and their caregiver). Using thematic analysis, we identified themes associated with social and emotional needs.
Results: Three themes were identified: 1) emotional challenges of adjusting to new roles and increased independence; (2) the importance of mental health for adults with CP and caregivers alike; and (3) the value of social supports. Within these areas, a range of specific challenges were discussed, including troubles fulfilling adult roles and responsibilities, managing sadness and anxiety, and connecting with other adults with similar histories and current circumstances.
Conclusions: These findings elucidate our understanding of the social and emotional complexities of navigating adulthood with CP and point to potentially helpful programs to support the unique constellation of needs that are often faced. This may include targeted psychotherapeutic services and structured opportunities to meet other adults with similar histories.
Plain language summary
Cerebral palsy is often associated with emotional and social difficulties in childhood, though few studies have focused these aspects of functioning into adulthood. Our qualitative findings highlighted challenges of adjusting to new roles and increased independence, the importance of mental health for adults with cerebral palsy and their caregivers, and the value of social and community supports. These findings suggest that many adults with cerebral palsy and their caregivers stand to benefit from emotional and social supports. There are multiple clinical services that may be useful, depending on the needs of the patient and their support system, including targeted psychotherapeutic services and structured opportunities to meet other adults with similar histories.
PMID: 40536496

Prevention and Cure

39.Neurological Outcomes in Late Preterm Infants: An Updated Review of Recent Research and Clinical Insights

Andreea-Ioana Necula, Roxana Stoiciu, Razvan Radulescu Botica, Cristiana-Elena Durdu, Roxana Bohiltea

Review Diagnostics (Basel) . 2025 Jun 14;15(12):1514. doi: 10.3390/diagnostics15121514.

Abstract
Research on late preterm infants is limited compared with extremely low birth weight infants, despite their vulnerability to brain injury. Early intervention is crucial, as these infants often face higher risks of cerebral palsy and developmental delays. This review examines methods to predict neurological outcomes and evaluates standard care protocols for neurologically affected late preterm infants. It also explores the potential for developing a comprehensive care bundle that integrates family involvement and delineates the responsibilities for continuous developmental monitoring. A total of 21 studies, primarily cohort studies, were included. This review synthesizes recent research on neurological development in late preterm infants, highlighting key markers and methods to improve neurological monitoring and long-term outcomes. Late preterm infants are at an increased risk for neurodevelopmental impairments, such as cerebral palsy and cognitive delays, particularly when growth restrictions or low birth weight are present. Early interventions, including specialized neurological assessments and targeted rehabilitation, show potential for improving these outcomes. Late preterm infants face increased neurodevelopmental risks despite low perinatal mortality. Early identification, standardized assessments, and targeted follow-up are essential. Emerging interventions show promise, but further research and equitable care access are needed to improve long-term outcomes.
PMID: 40564834

40.Testing Higher Doses of Sildenafil to Repair Brain Injury Secondary to Birth Asphyxia: An Open-Label Dose-Finding Phase 1b Clinical Trial (SANE-02)

Pia Wintermark, Anie Lapointe, Gabriel Altit, Robin Steinhorn, Emmanouil Rampakakis, Andreas D Meid, Jürgen Burhenne, Gzona Bajraktari-Sylejmani, May Khairy, Marie-Therese Adamo, Guillaume Gilbert, Daniela Toffoli, Samara Zavalkoff, Thuy Mai Luu, Elizabeth Hailu, Walter E Haefeli

J Pediatr . 2025 Jun 23:114701. doi: 10.1016/j.jpeds.2025.114701. Online ahead of print.

Objective: To evaluate the safety and tolerability of higher doses of sildenafil in neonates with hypoxic-ischemic encephalopathy (HIE) and brain injury.
Study design: A phase 1b open-label, dose-finding clinical trial in neonates with moderate-severe HIE and confirmed brain injury on a day-2 magnetic resonance imaging during therapeutic hypothermia (TH). Enteral sildenafil was administered q12h for 7 days. All participants received an initial dose 2.0 mg/kg, and a second dose of 2.5 mg/kg. Starting from the third dose, group 1 received 2.5 mg/kg q12h and group 2 received 3.0 mg/kg q12h. Primary outcome was incidence of dose-limiting toxicities. Secondary outcomes explored day-30 neuroimaging and 18-month neurodevelopment.
Results: Among 30 neonates between October 2019 and December 2021, 20 displayed day-2 brain injury and 13 received sildenafil (8 in group 1; 5 in group 2). In group 1, 25% (2/8) experienced transient hypotension after the first dose, linked to antiseizure medications. No significant hypotension occurred in group 2 when sildenafil was administered separately. At the 3.0 mg/kg/dose, steady-state sildenafil concentrations persisted beyond TH. Death or significant 18-month neurodevelopmental impairment occurred in 50% (4/8) of group 1 and 60% (3/5) of group 2. Among survivors, partial recovery of brain injury was seen in 80% (4/5) of group 1 and 75% (3/4) of group 2; cerebral palsy developed in 0% (0/5) and 50% (2/4), respectively.
Conclusions: Enteral sildenafil up to 3.0 mg/kg q12h was safe and well tolerated in a small single-center cohort of neonates with HIE treated with TH. Phase 2 trials are needed to assess multicenter feasibility and efficacy.
PMID: 40562301

41.A Comprehensive Review of the Pathophysiology of Neonatal Stroke and a Critique of Current and Future Therapeutic Strategies

Victor Mondal, Emily Ross-Munro, Gayathri K Balasuriya, Ritu Kumari, Md Munnaf Hossen, Mohammed Ageeli, Kate Firipis, David R Nisbet, Glenn F King, Richard J Williams, Pierre Gressens, Jeanie L Y Cheong, Flora Y Wong, David W Walker, Mary Tolcos, Bobbi Fleiss

Review Cells . 2025 Jun 16;14(12):910. doi: 10.3390/cells14120910.

Abstract
Within the first 28 days after birth, more than 1 in every 2500 newborns will suffer a stroke. The weekly-adjusted risk of stroke for a term-born infant is threefold higher than for a male smoker aged 50 to 59 years with hypertension and diabetes. Neonatal stroke has significant clinical and socio-economic consequences, leading to cerebral palsy, epilepsy, and a range of motor, sensory, and cognitive impairments. Currently, there is no treatment for the brain damage caused by neonatal stroke. In this review, we outline the differences in the complex interplay of inflammation, excitotoxicity, oxidative stress, and cell death after stroke between adults and neonates, which limits the direct transfer of knowledge between studies for understanding injury. We comprehensively document what is known about the pathophysiology of neonatal stroke and critically evaluate current therapeutic strategies, emphasising the urgent need for innovative treatments tailored to suit the neonatal brain. This analysis reveals that treatment with an injectable hydrogel scaffold, a three-dimensional, water-swollen polymer network, may be an innovative, viable approach to improve outcomes for infants suffering from the most severe forms of brain injury arising from neonatal stroke.
PMID: 40558537

42.Peritoneal drainage versus laparotomy as initial treatment for surgical necrotising enterocolitis or spontaneous intestinal perforation in preterm very low birth weight infants

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Review Cochrane Database Syst Rev . 2025 Jun 24;6(6):CD006182. doi: 10.1002/14651858.CD006182.pub3.

Rationale: Laparotomy and peritoneal drainage are two options for managing preterm very low birth weight infants with surgical necrotising enterocolitis (NEC) or spontaneous intestinal perforation (SIP). Peritoneal drainage has the theoretical benefit of avoiding surgery, whereas laparotomy enables the surgeon to directly visualise the intestines and undertake appropriate interventions. There is debate as to which method is superior. This is an update of a Cochrane review first published in 2011.
Objectives: To evaluate the benefits and harms of peritoneal drainage compared to laparotomy as the initial treatment for surgical NEC or SIP in preterm very low birth weight infants.
Search methods: We searched CENTRAL, MEDLINE, Embase, CINAHL, and two trial registries, together with reference checking, citation searching, and contact with study authors to identify the studies that are included in the review. The latest search date was December 2024.
Eligibility criteria: We included all randomised controlled trials (RCTs) or quasi-RCTs in preterm (< 37 weeks gestation) infants with very low birth weight (< 1500 g) with surgical NEC or SIP allocated to peritoneal drainage or laparotomy as initial surgical treatment. Intestinal perforations due to other causes were excluded.
Outcomes: The main outcomes of interest were mortality or neurodevelopmental impairment (NDI) at 18 to 24 months, NDI at 18 to 24 months among survivors, moderate to severe cerebral palsy at 18 to 24 months, mortality before discharge, mortality before 18 to 24 months corrected age, and subsequent laparotomy during initial hospital stay.
Risk of bias: We used the original Cochrane risk of bias tool (RoB 1) to assess bias in the included RCTs.
Synthesis methods: We synthesised results for each outcome using meta-analysis, where possible, by calculating risk ratios (RR) and mean differences (MD) with 95% confidence intervals (CI) for dichotomous outcomes and continuous outcomes, respectively. Where this was not possible due to the nature of the data, we summarised the results narratively. We used GRADE to assess the certainty of evidence for each outcome.
Included studies: We included three trials with a total of 496 preterm very low birth weight infants, of which 469 (94.6%) had a birth weight of less than 1000 g. Two trials were conducted in North America. One multi-centre trial was conducted in the UK, Europe, Asia, New Zealand, and Australia. The overall risk of bias in all three included trials was low, but the nature of the intervention meant that parents, caregivers, or clinical investigators were aware of the intervention groups.
Synthesis of results: Peritoneal drainage compared to laparotomy Peritoneal drainage likely results in little to no difference in mortality or NDI at 18 to 24 months (RR 1.02, 95% CI 0.88 to 1.19; risk difference (RD) 0.01, 95% CI -0.09 to 0.12; 1 trial, 295 infants; moderate-certainty evidence) and NDI at 18 to 24 months among survivors (RR 1.01, 95% CI 0.79 to 1.29; RD 0.01, 95% CI -0.13 to 0.14; 1 trial, 206 infants; moderate-certainty evidence). Peritoneal drainage likely increases the risk of moderate to severe cerebral palsy (RR 1.69, 95% CI 1.00 to 2.86; RD 0.12, 95% CI 0.00 to 0.23; number needed to treat for an additional harmful outcome (NNTH) 8.3; 1 trial, 210 infants; moderate-certainty evidence). Peritoneal drainage likely results in little to no difference in mortality before discharge (RR 1.12, 95% CI 0.82 to 1.54; RD 0.03, 95% CI -0.06 to 0.12; I2 = 0%; 2 trials, 378 infants; moderate-certainty evidence) and mortality before 18 to 24 months of age (RR 1.06, 95% CI 0.74 to 1.50; RD 0.02, 95% CI -0.09 to 0.12; 1 trial, 308 infants; moderate-certainty evidence). Infants in the peritoneal drainage group are more likely to need subsequent laparotomy during the first hospital stay (RR 2.26, 95% CI 1.73 to 2.95; RD 0.28, 95% CI 0.20 to 0.36; I2 = 0%; 3 trials, 492 infants; moderate-certainty evidence).
Authors' conclusions: Peritoneal drainage, when compared to laparotomy, likely results in little to no difference in mortality or overall neurodevelopmental outcomes at 18 to 24 months of age, and mortality before initial hospital discharge in preterm very low birth weight infants with surgical NEC or SIP. However, peritoneal drainage likely results in an increase in the risk of moderate to severe cerebral palsy. In addition, infants in the peritoneal drainage group are more likely to need subsequent laparotomy during the first hospital stay. In the absence of any substantial ongoing RCTs, clinicians may have to use the existing evidence to make management decisions.
Funding: This Cochrane review had no dedicated funding.
Registration: Protocol available via doi.org/10.1002/14651858.CD006182. 2011 published review available via doi.org/10.1002/14651858.CD006182.pub2.
PMID: 40552573

43.Brain State of the Newborn as a Biomarker for Brain Injury in Infants with Hypoxic-Ischemic Encephalopathy

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J Pediatr . 2025 Jun 21:114702. doi: 10.1016/j.jpeds.2025.114702. Online ahead of print.

Objective: To evaluate the use of a fully automated trend measure of cortical activity, Brain State of the Newborn (BSN), in early stratification of infants for add-on neuroprotective therapies during therapeutic hypothermia (TH).
Study design: Retrospective cohort study including 167 infants with moderate to severe hypoxic-ischemic encephalopathy, undergoing TH and continuous electroencephalography monitoring. The BSN trends were computed using fully automated pipelines, and we used a priori defined thresholds at 6, 12, 24 and 36 hours after birth to assess prediction of an adverse post-rewarming MRI, defined as moderate to severe cortical or deep gray matter injury and/or severe white matter injury. Adverse outcome at 2 years of age was defined as death, cerebral palsy or cognitive/motor scores <85 on the Bayley Scales of Infant Development-III.
Results: BSN-based prediction of an adverse MRI outcome at 12-24 hours after birth showed high sensitivity (81-87%) and specificity (73-81%), and the corresponding area under the curve (AUC) ranged from 83% at 6 hours to 93% at 24 hours, stabilizing at 91% by 36 hours. In contrast, the prediction of adverse outcome at 2 years of age at 12-24 hours showed a moderate sensitivity (73-77%) and specificity (70-78%, AUC: 70%), while mortality prediction achieved high sensitivity (94-99%) and specificity (69-75%, AUC: 96%).
Conclusion: BSN offers a fully automated and unbiased measure of recovery in spontaneous cortical activity, holding promise for a bedside biomarker in identifying infants who could benefit from early add-on neuroprotective therapies.
PMID: 40550308

44.Inter-observer variability in scoring of white matter injury on brain magnetic resonance imaging in moderate-to-late preterm infants

Kyle Grabowski, Liam Olsen, Greg Gamble, David Perry, Jane Harding

Pediatr Radiol . 2025 Jun 20. doi: 10.1007/s00247-025-06297-0. Online ahead of print.

Background: Punctate white matter injury on brain magnetic resonance imaging (MRI) is described in very preterm infants (< 32 weeks' gestation) and is predictive of poorer developmental outcomes. The reliability of scoring and the incidence and evolution of white matter injury in moderate-late preterm infants is unknown.
Objective: To assess inter-observer variability in white matter injury using a published scoring system (UCSF system), and to describe changes over time in moderate-late preterm infants.
Materials and methods: Infants born between 32 + 0 and 36 + 6 weeks' gestation in the Auckland region underwent MRI scans as soon as clinically feasible after birth and again at term-equivalent age. De-identified scans were scored independently by two observers. White matter injury was graded as minimal (< 3 lesions measuring < 2 mm), moderate (> 3 lesions or lesions > 2 mm), or severe (> 5% hemispheric involvement). Scores were compared between reviewers using weighted and unweighted kappa statistics interpreted using Cohen's criteria. Incidences were compared between scans using generalised estimating equations.
Results: Scans of 101 infants were assessed. Inter-observer agreement was near perfect for the presence of white matter injury (k = 0.88 and 0.81 for the first and second scan respectively), and for the severity of white matter injury was near perfect at the first scan (k = 0.85) and substantial at the second scan (k = 0.80). The incidence of white matter injury detected by the two observers decreased between the first and second scans (30% to 22% and 29% to 19%), and severity also decreased.
Conclusions: This scoring system can be reliably applied in moderate-late preterm infants. White matter injury is common in moderate-late preterm infants but may be underestimated when MRI is performed close to term-equivalent age.
PMID: 40540024

45.Real-World Therapeutic Hypothermia for Neonatal HIE: Neurodevelopmental Outcomes and Predictors

Luca Bedetti, Licia Lugli, Isotta Guidotti, Maria Federica Roversi, Elisa Della Casa Muttini, Marisa Pugliese, Natascia Bertoncelli, Eugenio Spaggiari, Alessandra Todeschini, Gina Ancora, Sara Grandi, Giancarlo Gargano, Claudio Gallo, Mario Motta, Piero Catenazzi, Luigi Tommaso Corvaglia, Vittoria Paoletti, Agostina Solinas, Elisa Ballardini, Serafina Perrone, Sabrina Moretti, Marcello Stella, Alberto Berardi, Fabrizio Ferrari

Acta Paediatr . 2025 Jun 18. doi: 10.1111/apa.70186. Online ahead of print.

Aim: This study assessed neurodevelopmental outcomes in neonates with hypoxic-ischemic encephalopathy (HIE) treated with therapeutic hypothermia (TH) outside randomised controlled trials (RCTs). It also aimed to identify predictors of outcomes and evaluate TH practices across centres.
Methods: A prospective, area-based observational study was conducted in eight Italian NICUs (2016-2021), including neonates treated with TH for any grade of HIE. A 2-year neurodevelopmental follow-up was performed. Severe functional disability (SFD) was defined as cerebral palsy (Gross Motor Function Classification Level > 2), cognitive score < 2 SD, bilateral blindness/deafness, or epilepsy. Demographic, clinical and MRI data were analysed.
Results: Among 283 cooled infants, 11 (3.8%) died and 272 (96.2%) survived. HIE severity was mild (14.0%), moderate (76.1%) and severe (9.9%). Follow-up data were available for 232 (85.3%) survivors, with SFD diagnosed in 27 (11.6%). No infants with mild HIE developed SFD. Severe MRI anomalies were found in 51.9% of SFD cases, while 90.7% of non-SFD children had normal findings. cEEG/aEEG-confirmed seizures (OR = 12.9, CI 3.5-65.0) and severe MRI anomalies (OR = 0.24, CI 0.13-0.44) were strong SFD predictors (AUC = 0.95).
Conclusion: Mortality and SFD rates were lower than in RCTs. Seizures and severe MRI anomalies predicted poor outcomes. Further RCTs are needed to refine treatment criteria.
PMID: 40533883

46.Safety and feasibility of allogeneic cord blood-derived cell therapy in preterm infants with severe brain injury (ALLO trial): a phase-1 trial protocol

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BMJ Open . 2025 Jun 18;15(6):e100389. doi: 10.1136/bmjopen-2025-100389.

Introduction: Severe intraventricular haemorrhage (IVH) and white matter injury (WMI) are major neurological complications in preterm infants, leading to long-term neurodevelopmental impairments. Despite advances in neonatal care, effective treatments are lacking. Umbilical cord blood cell (UCBC) therapy shows neuroprotective potential, with autologous sources ideal but often not feasible due to the unpredictability of preterm births. Allogeneic UCBCs offer an alternative, although immunogenicity and human leucocyte antigen (HLA) compatibility present challenges with knowledge gaps in their relevance in neonatal populations. This study aims to assess the feasibility and safety of partially HLA-matched allogeneic UCBC therapy in preterm infants with severe brain injury.
Methods: The ALLO trial is an open-label, phase I, single-arm feasibility and safety study conducted at Monash Children's Hospital, Victoria, Australia. Preterm infants born before 28 weeks (ALLO-1) or between 28 weeks and 36+6 weeks (ALLO-2) gestational age with severe brain injury identified on neuroimaging will be enrolled. Severe brain injury is defined as grade 3 or 4 IVH or significant WMI. Exclusion criteria include major congenital anomalies or redirection to comfort care. Eligible infants will receive a single intravenous infusion of unrelated, allogeneic, partially HLA-matched (4/6 or 5/6 HLA match) UCBCs sourced from a public cord blood bank. The target dose is 50 million total nucleated cells per kilogram body weight. Infusion will occur within 2-3 weeks of confirmation of eligibility, contingent on clinical stability and absence of active sepsis. Primary outcome includes: (1) feasibility, defined as having more than 60% of enrolled infants with an eligible allogeneic partially matched cord blood unit available and (2) safety, defined as absence of severe adverse events within 48 hours of infusion or graft-versus-host disease within 3 months of infusion. Secondary outcomes include survival, neonatal morbidities, neurodevelopmental assessments and serum cytokine analysis.
Ethics and dissemination: Monash HREC has granted full ethics approval (RES-23-0000-297A) for the study, including the research use of allogeneic cord blood from compassionate donations by healthy donors, facilitated through the Bone Marrow Donor Institute Cord Blood Bank within the AusCord network. Findings will be disseminated through peer-reviewed publications and conference presentations, contributing to the development of novel neuroreparative therapies for preterm brain injury.
Trial registration number: ACTRN12623001352695 (The Australian New Zealand Clinical Trials Registry).
PMID: 40533219

47.Statistical learning to identify and characterise neurodevelopmental outcomes at 2 years in babies born preterm: model development and validation using population-level data from England and Wales

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EBioMedicine . 2025 Jun 17:117:105811. doi: 10.1016/j.ebiom.2025.105811. Online ahead of print.

Background: Children born preterm face elevated risks of neurodevelopmental impairments across domains. Prior studies have relied on expert-imposed typologies within single domains. This study applies statistical learning to a national database to identify transdomain clusters and their maternal and neonatal predictors.
Methods: Latent class analysis (LCA) was used to derive transdomain clusters from parent-reported visual, auditory, neuromotor, and communication impairments in preterm-born children at two years corrected age using the UK National Neonatal Research Database data (N = 27,261). Replication was conducted in an independent sample from Wales (N = 975). Clusters were clinically validated using cerebral palsy diagnosis, Bayley Scales of Infant and Toddler Development (3rd edition), and global neurodevelopmental delay. Random forest identified cluster-specific and shared predictors.
Findings: Four homogeneous clusters were derived (silhouette score = 0.71) and replicated in Wales with high balanced accuracy (93%): (1) typically developing (84.8%), (2) communication impairments (8.4%), (3) neuro-motor impairments (4.1%), and (4) multiple neuro-morbidity (2.7%). Clusters had high clinical validity and were distinguishable by shared and cluster-specific predictors. Neonatal brain injuries were most predictive of neuro-motor and multiple neuro-morbidity clusters. Birthweight, gestational age, socio-economic deprivation, and sex were stronger predictors of the communication cluster than preterm co-morbidities.
Interpretation: This study provides first evidence of the transdomain nature of neurodevelopmental impairments after preterm birth using LCA. The finding that socio-demographic and perinatal factors rather than co-morbidities increase the risk of communication impairment highlights the importance of environmental modification alongside clinical interventions. Applying data-driven approaches to routinely collected data may offer a cost-effective way to stratify at-risk children and inform targeted support strategies.
Funding: UKRI Medical Research Council.
PMID: 40532624

48.Characterization of Clinical Magnetic Resonance Imaging Findings in Moderate-Late Preterm Infants Diagnosed With Cerebral Palsy: A Single-Center Retrospective Study

Elizabeth Fisher, Jessica Tartakovsky, Laura A Bliss, Alok Jaju, Jessie Aw-Zoretic, Laura Vernon, Divakar S Mithal

Pediatr Neurol . 2025 May 26:169:148-155. doi: 10.1016/j.pediatrneurol.2025.05.021. Online ahead of print.

Background: Cerebral palsy (CP) is the most common movement disorder in childhood and is associated with both brain injury and prematurity. Approximately 10% of patients have a normal brain magnetic resonance imaging (MRI), and current practices suggest genetic testing may be indicated for those patients. However, given that prematurity itself is a risk factor for CP, which MRI patterns are present in premature infants and whether MRI patterns are associated with genetic causes in this population are unclear. While white matter injury is the dominant underlying cause of CP in premature infants, moderate prematurity between 32 and 34 weeks' gestational age represents a transitional period to a more diverse set of CP-causing brain injuries.
Methods: A single-center retrospective case review of a 65 CP patient cohort was performed. Patients were identified as moderate-late preterm infants based on gestational age in the EMR, and those who had MRI reports available in the medical record, was analyzed. Five subcategories of MRI findings were defined as follows: 1) normal, 2) nonspecific, unlikely causal, 3) nonspecific, likely causal, 4) acquired pathology, and 5) congenital/structural. Comorbidities, disease burden, and genetic testing were compared across the imaging subcategories with no notable differences identified.
Results: Initial review indicated that 95% of patients fall into an abnormal MRI category. Genetic testing was sent on 34% of patients in the cohort and a diagnosis was identified in 13% of all patients, but no statistical differences in genetic testing were noted across MRI groups. Respiratory status, feeding status, rates of epilepsy, verbal status, ambulatory status, and intellectual disability were not statistically different between MRI categories.
Conclusions: In this single-center cohort of moderate-late preterm infants with CP, abnormal MRI findings were identified frequently. However, for this cohort, abnormal imaging findings were not correlated with either disease burden or genetic testing utilization.
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49.Prediction of motor outcome in preterm infants with punctate white matter lesions using term equivalent age MRI

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Introduction: This study assessed whether magnetic resonance imaging (MRI) at term equivalent age (TEA-MRI) is as predictive as preterm MRI, when using a white matter imaging rule which scores punctate white matter lesions (PWMLs) according to their location anterior or posterior to the midventricular line in a transverse plane. In addition, we assessed the number of PWMLs and their location in the coronal and sagittal planes.
Methods: Retrospective study, 41 preterm neonates <32 weeks' gestation with PWMLs on TEA-MRI and follow-up at two years corrected and/or 5-8 years of age. Scans were analysed in all planes, follow-up was assessed using standardized tests.
Results: 18/41 infants (44 %) had adverse motor outcome, six had cerebral palsy (CP). In the transverse plane, 13/21 (62 %) infants with PWMLs anterior to the midventricular line, had adverse outcome and six (29 %) CP. In the coronal plane, 11/18 (61 %) with lesions crossing the posterior limb of internal capsule, had adverse motor outcome and five (28 %) CP. In the sagittal plane, 11/14 (79 %) infants with lesions crossing the central sulcus, had adverse motor outcome and six (43 %) CP. On the TEA-MRI, lesions anterior to the midventricular line in the transverse plane were predictive of adverse motor outcome. Involvement of the central sulcus in the sagittal plane had the highest predictive value.
Conclusion: The white matter imaging rule on preterm MRI is also of predictive value for motor outcome when used on the TEA-MRI. PWML location relative to the central sulcus in the sagittal plane was most predictive of adverse motor outcome.
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