Cerebral palsy research news

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Interventions and Management

1.Response by Author to Reader's Comment "Hand Functions Following Prone-weight Bearing on Upper Limb with Active Elbow Extension versus Modified Constraint-Induced Movement Therapy in Children with Unilateral Cerebral Palsy: A Randomized Clinical Trial" by Narayan et al. (2025)

Amitesh Narayan

NeuroRehabilitation. 2025 Sep 12. Online ahead of print

Abstract
No abstract available
PMID: 40938805

2.Unraveling tactile and proprioceptive upper limb function in children with unilateral cerebral palsy: a combination of robotic and clinical assessments

Lize Kleeren, Lisa Mailleux, Monica Crotti, Lisa Decraene, Geert Verheyden, Olivier Lambercy, Els Ortibus, Anja Van Campenhout, Hilde Feys, Katrijn Klingels

Disabil Rehabil. 2025 Sep 11:1-22. Online ahead of print

Purpose: To map somatosensory impairments in the more-impaired and less-impaired upper limb of children with unilateral cerebral palsy (uCP) compared to typically developing children (TDC), using clinical and robotic assessments. Additionally, we explored which subgroups of children with uCP are more likely to experience somatosensory impairments.
Materials and methods: This cross-sectional study included 49 children with uCP (11y11m ± 2y10m, 26 males) and 49 age- and sex-matched TDC (11y10m ± 2y10m). Tactile registration (Semmes-Weinstein monofilaments), tactile perception (stereognosis, two-point discrimination), and proprioception (clinical movement sense, ETH MIKE robot, and Kinarm exoskeleton) were assessed. Differences between groups and across manual ability levels and brain lesion types were analyzed using generalized estimating equation models.
Results: Children with uCP exhibited tactile impairments in both hands (more-impaired: 27–43%; less-impaired: 12–16%) and worse proprioception bilaterally compared to TDC ($p \leq 0.003$). Lower manual ability was related to worse tactile perception ($p \leq 0.001$) and proximal proprioception ($p \leq 0.045$). Predominant grey matter lesions were correlated with worse tactile registration ($p = 0.016$), perception ($p \leq 0.009$), and distal proprioception ($p = 0.009$).
Conclusions: Our results underline the importance of including clinical and robotic assessments in the follow-up of children with uCP to identify bilateral somatosensory impairments. An international consensus on clinically relevant and well-defined assessment protocols is needed to enhance clinical translation.
PMID: 40936256

3.Effectiveness of multisensory stimulation and priming (MuSSAP) upper limb training in 3–8 months old infants with unilateral brain lesion – a retrospective clinical cohort study

Anke Verhaegh, Lisa Mailleux, Maria Nijhuis-van der Sanden, Pauline Aarts, Michèl Willemsen, Brenda Groen

Early Hum Dev. 2025 Sep 3;210:106388. Online ahead of print

Introduction: Multi Sensory Stimulation And Priming (MuSSAP) is an early upper limb training for infants at high risk of unilateral cerebral palsy (CP). MuSSAP is designed to enhance awareness of the affected upper limb facilitating initiation of goal-directed movements. This study assesses the effectiveness of an 8-week MuSSAP training on manual ability in a clinical setting.
Participants and methods: Twenty-eight infants (mean corrected age at T0: 5.0 months) were included in a retrospective clinical cohort study with assessments pre- (T0), post- (T1) and at 8-week follow-up (T2) using the Hand Assessment for Infants (HAI). The primary outcome was the HAI 'affected hand score', secondary outcomes included the 'unit score' and item 1 ('initiates to side'). Data were analysed using linear mixed models.
Results: HAI scores improved between T0–T1 ($n = 25$) for both affected hand score (estimate: 3.2, $p < 0.001$), and unit score (estimate: 9.7, $p < 0.001$). Scores remained stable between T1–T2. The number of infants who never initiated or only when restrained/sometimes initiated or only when prompted/almost always spontaneously initiated goal-directed movements changed from 8/13/7 at T0 to 5/5/15 at T1 (three missing). Of the five infants who did not initiate goal-directed movements after training, three had drug-resistant epilepsy.
Conclusion: MuSSAP appears to improve manual ability in infants at high risk of unilateral CP in a clinical setting. A larger randomized controlled trial incorporating brain-based measures is needed to further investigate its effectiveness and working mechanism, especially for infants who do not initiate goal-directed movements with the affected upper limb.
PMID: 40925300

4.3D ultrasonic visualization of hip displacement: A phantom study

Trang H Hoang, Thanh-Tu Pham, Edmond H Lou, Thanh-Giang La, Jiaqing Wang, Lawrence H Le

Ultrasonics. 2025 Sep 6;158:107808. Online ahead of print

Abstract
Hip displacement is common in children with cerebral palsy (CP). Reimer's migration percentage (MP) measured on radiographs is the gold standard for assessing hip displacement. This phantom study was a proof-of-concept investigation, which aimed to evaluate the accuracy of MP measurements on the 3D reconstructed ultrasound (US) hip images. Two 3D printed pediatric hip phantoms with known MPs were scanned anteriorly along the superior-inferior direction to acquire two series of 2D US transverse images at 0.5 mm intervals using a handheld ultrasound scanner. Following image acquisition, the 2D images were consecutively stacked to create 3D reconstructed images. A morphological operation was applied to the coronal slices of the 3D images to correct for elevation thickness artifacts. Least-squares sphere fitting was employed to estimate the width of the femoral head (FH). A comparison of the measured MPs from the reconstructed US images and digital phantoms was reported. The US MP-values were also compared with those from clinical standard radiography and 2D circle-fitting method. The proposed 3D US method delivered the most accurate MP measurements up to a maximum error of 1.16 % compared to the ground truth phantom measurements. In contrast, the radiography and circle-fitting methods were off by 7.6 % and 16.82 %, respectively. The proof-of-concept study using phantoms has shown that the US-based measurements from 3D images provide much more accurate MP-values than the conventional X-ray method and 2D-based US measurements. Further validation using in-vivo data will show the potential of the radiation-free method in providing better patient care.
PMID: 40939499

5.Surgical treatment of hip dysplasia in cerebral palsy: A retrospective comparison between open and closed reduction

Marcio Vieira Sanches Silva, Bárbara Lívia Corrêa Serafim, Luiz Renato Agrizzi de Angeli, Alexandre Zuccon

Medicine (Baltimore). 2025 Sep 5;104(36):e44245

Abstract
Hip dysplasia in cerebral palsy (CP) is a common and severe problem, especially among nonambulatory patients. A likely cause is muscular imbalance and developmental bone changes leading to a progressive extrusion of the femoral head from the acetabulum. The ideal surgical treatment aims to reduce the dislocated hip to improve pain, positioning, and function. The purpose of this study is to clinically and radiographically compare the results of hip reconstructive surgery with or without open reduction in patients with CP and hip dysplasia. A retrospective study was conducted through access to medical records, radiographs, and clinical evaluation of patients with CP who underwent surgical correction of hip dysplasia through hip reconstructive surgery with a minimum of 2 years follow-up. Two surgical techniques were compared: open versus closed reduction. Clinical parameters such as pain, hip abduction, age, follow-up time, and the Caregiver Priorities and Child Health Index of Life with Disabilities Questionnaire were used. Radiographic evaluation included dislocation degree (hip status), Reimers migration percentage, and the presence or absence of osteonecrosis. One hundred thirty hips were included in the study, and 23.08% of patients underwent bilateral procedures. Thirty-three percent of patients were classified as gross motor function classification system IV and 67% were gross motor function classification system V. The mean preoperative Reimers migration percentage decreased from 77.4% to 7.6% in the open reduction group and from 76.0% to 6.2% in the closed group (P = .656). Postoperative hip abduction increased from 10° to 25° in the open group and from 13.2° to 24.2° in the closed group (P = .096). Caregiver Priorities and Child Health Index of Life with Disabilities Questionnaire scores showed no significant differences in Sections II, III, and VII. Osteonecrosis occurred in 50% of the open group and 45.3% of the closed group (P = .659). Both techniques were effective and had similar clinical and radiographic outcomes in treating hip dysplasia in patients with CP. Further prospective studies are necessary to clarify the best indications for each technique.
PMID: 40922345

6.The relationship between triceps surae muscle-tendon morphology and shear modulus across passive ankle range of motion in cerebral palsy

Francesco Cenni, Maria Sukanen, Alejandro Hernández-Belmonte, Iida Laatikainen-Raussi, Ines Vandekerckhove, Taija Finni

J Biomech. 2025 Sep 5;192:112946. Online ahead of print

Abstract
Alterations in skeletal muscle morphology and composition are critical factors in cerebral palsy (CP), including changes in passive stiffness and in belly and fascicle lengths. In this study, we quantified the relative contributions of muscle and tendon to passive stiffness across the ankle range of motion in individuals with CP and typically developing (TD) peers. We also investigated morphological factors underlying increased muscle stiffness. Twelve individuals with CP and 12 age-matched TD peers were recruited. 3D freehand ultrasonography was used to image the medial and lateral gastrocnemius, soleus, and Achilles tendon at three angles across the passive range of motion. From these datasets, muscle belly and fascicle lengths were estimated. Shear wave elastography assessed tissue passive stiffness. The shear modulus at the neutral ankle angle was significantly ($p < 0.0038$) higher in CP (26.8 kPa for the medial and 20.2 kPa for lateral gastrocnemius) than in TD (19.7 and 14.1 kPa, respectively). When relating shear modulus to muscle belly strain, a significantly steeper slope in CP (3.31 kPa) than in TD (1.00 kPa) ($p = 0.001$) was found. In the CP group, the slope of muscle belly strain differed significantly from that of fascicle strain, whereas no such difference was observed in the TD group. Our results confirm an increase in passive muscle stiffness in individuals with CP, which remains consistent across the joint range. This elevated stiffness seems primarily associated with whole muscle belly strain, suggesting that changes in the extracellular matrix, rather than fascicle elasticity, may be the main contributor.
PMID: 40921122

7.Quality of Life of Children with Cerebral Palsy and Its Association with Their Physical Activity Levels: A Cross-Sectional Study

Reem A Albesher, Reem M Basoudan, Areej Ghufayri, Dana Aldayel, Dareen Fagihi, Shahad Alzeer, Shaima Althurwi, Nouf Aljarallah, Turki Aljuhani, Mshari Alghadier

Healthcare (Basel). 2025 Aug 30;13(17):2166

Background/Objectives: Children, caregivers, and physicians may be insufficiently aware of the effect(s) of physical activity levels on the quality of life (QoL) of children with cerebral palsy (CP). This study aimed to understand the levels of physical activity of school-age children with CP compared with typically developing (TD) peers, and to examine the relationship between physical activity levels and the QoL of children with CP.
Methods: We conducted a cross-sectional study of children with CP and TD children aged 6-12 years. Parents of children with CP completed a four-section survey: demographic information, parent-reported Gross Motor Functional Classification System, physical activity, and the CP-QoL questionnaire. Parents of TD children completed the demographic and physical activity sections. To account for the severity of motor impairment associated with CP, further analysis was conducted to compare QoL between the ambulant and non-ambulant groups of children with CP.
Results: Eighty-two participants were included in the analysis: 42 children with CP and 40 TD children (8.29 ± 1.79 years; 8.35 ± 1.76 years). The lowest QoL domain scores were access to service, pain, and effect(s) of disability. Children with CP reported similar physical activity levels to those of the TD children. Physical activity levels were associated with the general QoL score, and feeling-social domains of QoL.
Conclusion: Our findings support the positive prediction of high physical activity levels with QoL among school-aged children with CP.
PMID: 40941518

8.Behavioural Interventions to Treat Oropharyngeal Dysphagia in Children with Cerebral Palsy: A Systematic Review of Randomised Controlled Trials

Michelle McInerney, Sarah Moran, Sophie Molloy, Carol-Anne Murphy, Bríd McAndrew

J Clin Med. 2025 Aug 25;14(17):6005

Background/Objectives: Swallowing disorder(s), or oropharyngeal dysphagia (OPD), are very common in children with cerebral palsy (CP) and pose a significant risk to their health. Behavioural interventions are frequently recommended when targeting OPD in children with CP; however, their efficacy has yet to be determined. This systematic review aimed to synthesise the current evidence for behavioural interventions in the treatment of OPD in children with CP.
Methods: A comprehensive search in six databases in October 2024 sought studies that (1) included participants aged 0-18 years with a diagnosis of CP and OPD; (2) utilised and described a behavioural intervention for OPD; and (3) used a randomised controlled trial (RCT) experimental design. Three reviewers independently extracted the data, and results were tabulated. The Revised Cochrane Risk of Bias (ROB-2) tool was used to determine the methodological quality of eligible articles.
Results: From an initial yield of 2083 papers, 99 full-text studies were screened for eligibility. Seven RCTs involving 329 participants aged 9.5 months (SD = 2.03) to 10.6 yrs were included. CP description varied. Most studies used a combination of behavioural interventions to treat OPD (n = 6), and oral sensorimotor treatment was the most frequently utilised treatment (n = 4). Positive outcomes were reported in all (n = 7); however, there was high risk of bias in five studies.
Conclusions: The use of behavioural interventions to treat OPD in children with CP continues to be supported by low-level evidence. Rigorously designed RCTs with larger samples of children with CP and OPD are needed to evaluate the true effects of behavioural interventions across the developmental phase of childhood. Importantly, consistency in describing and reporting baseline analysis of swallowing and OPD; together with treatment-component data, is a priority in future research.
PMID: 40943765

9.Clinical and maternal factors associated with pain and quality of life in children with cerebral palsy

Manel Abid, Roseline Galipeau, Mariem Gaddour, Sahbi Mtaoua, Rihab Moncer, Sonia Jemni

Afr J Disabil. 2025 Aug 18;14:1731. eCollection 2025

Background: Cerebral palsy (CP) represents the most common and disabling motor disorder in childhood. It can lead to chronic pain and reduced quality of life (QOL). These challenges can also affect mothers, who are typically the primary caregivers, contributing to physical and psychosocial strain.
Objectives: This study explored the associations between motor impairment, chronic pain, and QOL in children with CP, as well as maternal stress and pain intensity, and examined their mediating roles.
Method: A cross-sectional study was conducted with 132 mother-child dyads in Tunisia. Children were aged 4 to 12 years. The Gross Motor Function Classification System, the Cerebral Palsy Quality of Life Questionnaire, the Visual Analogue Scale, and the Perceived Stress Scale were used to assess motor impairment, quality of life, and chronic pain intensity in children with CP, as well as maternal pain intensity and stress.
Results: Motor impairment was significantly associated with lower child QOL ($\beta = -0.671$; SE = 0.657, $p < 0.001$) and higher pain intensity ($\beta = 0.5$; SE = 1.213, $p < 0.001$). Maternal stress partially mediated the relationship between motor impairment and child QOL (Sobel test = -4.073; $p < 0.001$). Maternal pain also partially mediated the relationship between motor impairment and child pain (Sobel test = 2.505; $p = 0.012$).
Conclusion: These findings highlight the significant impact of motor impairment on QOL and chronic pain intensity in children with CP.
Contribution: This study emphasises the mediating roles of maternal stress and pain intensity, suggesting that interventions should address both the physical symptoms of CP and the psychosocial well-being of children and their mothers.
PMID: 40937277

10.Psychological Predictors of Pain Outcomes in Children With Cerebral Palsy Undergoing Orthopaedic Surgery

Elizabeth R Boyer, Allison G Corlett, Kyle Nickodem, Frank J Symons, Tom F Novacheck, Chantel C Burkitt

J Pediatr Orthop. 2025 Oct 1;45(9):531–539. Epub 2025 May 7

Background: Many children with cerebral palsy (CP) undergo orthopaedic surgery. Prospective studies exploring patient or psychological factors predictive of pain recovery or chronicity have not been investigated in CP and orthopaedic surgery. In studies with other pediatric clinical samples, preoperative pain, anxiety, and catastrophizing were shown to be predictive of pain outcomes. The purpose of this exploratory study was to (a) quantify pain presence longitudinally before and after orthopaedic surgery in children with CP and (b) identify preoperative factors associated with postoperative pain intensity and interference.
Methods: Parents of 36 children (mean age = 12 y, range = 4 to 17) completed online surveys at 1 week preoperative, and 1, 3, 6, and 12 months after spinal fusion (n = 10), multilevel lower extremity surgery (n = 20), or other orthopaedic surgery (n = 6). Pain interference (Brief Pain Inventory-Pain Interference), pain intensity (Numerical Rating Scale 0 to 10), and chronic postsurgical pain (CPSP; new or worsening pain) were the outcome variables. Multilevel modeling was used to identify whether participant demographics (e.g., age, sex, gross motor ability) and psychological factors (parent pain catastrophizing and grit) were associated with pain interference and intensity outcomes.
Results: There was significant variability in pain experience between participants. Moderate to severe pain affected about one-third of participants at all time points, with about one-quarter of participants meeting the criteria for CPSP. Higher parent pain catastrophizing and lower grit were associated with greater pain intensity and interference. Participant age, sex, gross motor ability, and number of prior surgeries were not related to pain outcomes.
Conclusions: Pain, including moderate to severe pain, was experienced by a substantial proportion of children with CP in this sample both before and after orthopaedic surgery. There is initial evidence that psychological factors may be viable predictors of postsurgical pain outcomes, highlighting opportunities for screening and intervention, though further research is needed.
PMID: 40928182

11.Diagnostic accuracy of ultrasound for dysphagia in neurological disorders including stroke: a systematic review and meta-analysis

Liu Yang, Dongxue Liu, Dai Shuang, Liang Shuang, Yujiao Wang, Lan Gao

Front Neurol. 2025 Aug 21;16:1534173. eCollection 2025

Objective: To investigate the diagnostic accuracy of ultrasonography in detecting dysphagia and to compare it with other diagnostic methods.
Methods: This is a systematic review and meta-analysis of observational studies. The literature was searched in multiple databases, including the Cochrane Central Controlled Trials Registry; MEDLINE, EMBASE, Web of Science; CINAHL; and Chinese databases including Wanfang Data, CNKI, and VIP. Only articles published in English and Chinese were included. Studies were eligible if they compared the accuracy of ultrasound testing with that of other diagnostic methods in dysphagia patients. The Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) criteria were used to assess the risk of bias.
Results: We included eight studies involving a total of 538 patients with dysphagia: seven trials for post-stroke dysphagia and one trial for dysphagia in children with cerebral palsy. The combined results showed that the sensitivity and specificity of ultrasound were 0.81 (95% CI 0.73–0.87) and 0.86 (95% CI 0.76–0.93), suggesting that the diagnostic performance of ultrasound is reliable for detecting dysphagia in patients.
PMID: 40917665

12.The role of assistive devices and technologies in the activities and participation in everyday life of children with cerebral palsy – a scoping review

Dyon Hoekstra, Annett Thiele

Disabil Rehabil Assist Technol. 2025 Sep 10:1–22. Online ahead of print

Objectives: Many studies investigate the impact of assistive devices and technologies (AD/AT) on physical outcomes. The role of AD/ATs in everyday activities and participation of children with cerebral palsy (CP) has received much less attention. This review scopes the impact of AD/ATs by the activities and participation components of the International Classification of Functioning, Disability and Health (ICF) model.
Methods: Five databases (Pubmed, Web of Science, Eric, FIS Bildung, Wiso) were initially searched between May 2023 and July 2023. An updated search (also adding EBSCO) was conducted until December 2024. Inclusion criteria were: (1) Children diagnosed with CP, (2) exploring the impact of specific AD/ATs, (3) AD/ATs that were used by the child itself, (4) AD/ATs that were applied or tested in everyday life; (5) written in English or German; (6) published from 2007 onwards in a peer-reviewed journal.
Results: 8539 records were identified. 2673 duplicates were removed. Title and abstract screening excluded 4919 records. After full-text screening of 948 records 22 records were included. AD/ATs in the included studies ranged from adaptive seating devices to balance-based video games. Most AD/ATs addressed gross motor impairments, primarily walking, posture and mobility (19 out of 22).
Discussion: Findings suggest that AD/ATs can enhance independence in gross motor tasks, interpersonal interactions and self-care, which can promote autonomy and social participation. However, significant research gaps persist regarding their impact across a broader range of domains and further studies are needed to explore the full potential of AD/ATs over time and to improve outcome measures.
Plain language summary
The scoping review emphasises that the majority of assistive devices and technologies (AD/ATs) identified primarily address gross motor skills, such as walking, posture and mobility. This underscores the importance of rehabilitation interventions concentrating on these specific aspects to enhance the independence of children with cerebral palsy (CP). Rehabilitation programs should prioritise the development and utilisation of AD/ATs aimed at improving gross motor skills.The scarcity of reported fine motor AD/ATs and the focus on communication devices for speech motor impairments highlight gaps in rehabilitation strategies. To comprehensively address the needs of children with CP, rehabilitation efforts should extend beyond gross motor skills and encompass interventions targeting fine motor skills and communication. This underscores the necessity for developing and incorporating a wider range of AD/ATs to address diverse aspects of the lives of children with CP.The scoping review also reveals that AD/ATs contribute significantly to promoting the autonomy of children or adolescents with CP, especially in areas such as maintaining body position, self-care and communication. The findings underscore the importance of integrating AD/ATs in rehabilitation programs not only to enhance independence but also to alleviate caregiver burden. Rehabilitation strategies should prioritise interventions that empower children with CP in daily activities, reducing dependency on personal support and enhancing overall well-being.The current focus on mobility-related outcomes suggests a gap in understanding the broader implications of these devices. Rehabilitation programs should incorporate comprehensive, longitudinal assessments that consider the multifaceted aspects of a child's development. This necessitates the development of assessment tools capable of capturing changes over time in functions, activities and participation, moving beyond the predominantly mobility-centric approach reported in existing studies.
PMID: 40928660

13.Gross Motor Function after Rehabilitation with the Atlas 2030 Pediatric Exoskeleton in Children With Cerebral Palsy

Irma García Oliveros, Nerea Meabe Iturbe, Juan Ignacio Marín Ojea, Carolina Lancho Poblador, Paola Fuentes-Claramonte, José Ignacio Quemada Ubis

Rev Neurol. 2025 Aug 29;80(7):46141

Introduction and objectives: To evaluate the impact of intensive gait training on gross motor function using the pediatric exoskeleton ATLAS 2030, as well as to determine the post-intervention maintenance of effects in children with cerebral palsy (CP).
Subjects and methods: A non-randomized controlled prospective study. Thirteen children with CP participated. A program of four weekly sessions lasting 65 minutes each was implemented over six weeks. Gross motor function was assessed using the 88 items Gross Motor Function Measure (GMFM-88); physical exercise endurance was measured with the Six-Minute Walk Test (6MWT) using the device; the number of steps walked in each session and mode of use was recorded to evaluate adaptation to the activity. Three evaluations were conducted: before treatment, at the end of treatment (6 weeks), and a follow-up evaluation at 12 weeks.
Results: The total GMFM-88 score showed significant changes at the end of the intervention ($p < 0.001$), which persisted at follow-up ($p < 0.001$). The number of steps in automatic and active modes increased significantly after the intervention ($p < 0.001$) and were maintained at follow-up ($p = 0.001$). Lastly, the 6MWT improved significantly after the intervention, with a reduction observed at follow-up ($p < 0.001$).
Conclusions: Six weeks of intensive training with ATLAS 2030 positively impacts the gross motor function of children with CP, with benefits increasing six weeks after treatment completion. Physical endurance and adaptation to the activity improve with continued use. These results support the potential of ATLAS 2030 as an intensive therapeutic strategy for this population.
Clinical trial registration: No: NCT07066956. https://clinicaltrials.gov/search?cond=NCT07066956.

PMID: 40916964

14.Psychometric Properties of the Wheelchair Skills Test and the Wheelchair Skills Test-Questionnaire: Validity, Reliability, and Responsiveness in Children and Young Adults With Cerebral Palsy—Exploratory Study

Mari Naaris, Marco Konings, Inti Vanmechelen, Douwe Ravers, Els Ortibus, Elegast Monbaliu

Phys Occup Ther Pediatr. 2025 Sep 8:1–17. Online ahead of print

Purpose: To explore the concurrent validity and responsiveness of the Wheelchair Skills Test-Questionnaire (WST-Q) caregiver proxy, and the inter- and intra-rater reliability of the Wheelchair Skills Test (WST) in children and young adults with cerebral palsy (CP).
Methods: Concurrent validity and responsiveness of the WST-Q caregiver proxy were assessed in 12 participants with CP (mean age 15 years; SD: 3 years 6 months); power wheelchair users. Concurrent validity of the WST-Q was determined using Pearson's correlation coefficients, and responsiveness with linear regression. Inter- and intra-rater reliability of the WST were assessed with intraclass correlation coefficients (ICC) ($n = 4$).
Results: The WST-Q caregiver proxy showed good concurrent validity with WST total scores ($r = 0.623$, $p < 0.001$). No acceptable responsiveness was found for the WST-Q caregiver proxy ($R^2 = 0.317$, $p = 0.071$). Inter-rater reliability for the WST total scores was good (ICC = 0.864, $p < 0.001$); and intra-rater reliability ranged from good to excellent (Rater 1 ICC = 0.857; Rater 2 ICC = 0.904; Rater 3 ICC = 0.923, all $p < 0.001$).
Conclusions: The WST-Q caregiver proxy appears to be valid for assessing levels of wheelchair skills in children and young adults with CP, however, it lacks suitability to measure intervention effects due to its poor responsiveness. The WST appears reliable for measuring wheelchair skills in young adults with CP.
PMID: 40916583

15.The experience of cerebral palsy stigma amongst adults living in the UK and Ireland: A qualitative co-designed project

Kimberley J Smith, Jessica Burke, Rachel Lawrence, Emily Oputa, Ruth Bailey

PLoS One. 2025 Sep 9;20(9):e0331562. eCollection 2025

Background: There is evidence that cerebral palsy (CP) could be linked to stigma and discrimination, however current evidence is limited to small qualitative studies. The goal of this co-designed survey was to elicit information on experiences of stigma and discrimination amongst a larger sample of adults in the UK and Ireland.
Methods: Quantitative questions about sources of stigma and qualitative questions designed to elicit information on experiences of stigma were shared via an online survey.
Results: Eighty-six people completed the qualitative survey, and 5 themes were generated that captured experiences of stigma and discrimination. Theme 1 (rigid stereotypes) captured the lack of awareness about the heterogeneity of CP. Theme 2 (impact on participation) highlighted the difficulties that participants had with participation, particularly in terms of accessibility and sexual relationships. Theme 3 (interpersonal difficulties) included the difficulties people with CP had in interactions with the public such as feel visible in some situations, invisible in others and being infantilised. Theme 4 (systematic discrimination) highlighted discrimination in the workplace, healthcare and broader environment. Theme 5 (negative emotional impact) captured the negative emotional impact that experiences of stigma and discrimination had. Quantitative responses from 48 participants indicated that stigma was a common experience (experienced by 87.5% of respondents), and the most common sources of stigma were the public, classmates and coworkers.
Conclusions: Results indicate that CP is linked to experiences of stigma and discrimination which arise from a lack of understanding of the heterogeneity of CP, a public lack of awareness of how to communicate with people with disabilities, inaccessible environments and negative societal attitudes towards visible impairments. Suggested ways to tackle these issues include improving understanding of CP and removing barriers to accessibility.
PMID: 40924707

16.A neuropsychological perspective on the proposed updated description of cerebral palsy

Kristine Stadskleiv, Olga Laporta-Hoyos, Júlia Ballester-Plané, Els Ortibus, Ingrid Honan, Petra Karlsson, Samudragupta Bora, Jacqueline N Kaufman, Seth Warschausky, Roser Pueyo

Dev Med Child Neurol. 2025 Sep 12. Online ahead of print

Abstract
No abstract available
PMID: 40944326

17.Child Neurology: Clinical and Imaging Findings in a Child With DHX37 Gene Variant: A Ribosomopathy Masquerading as Cerebral Palsy

Anika Menetrey, Mark Tarnopolsky, Sangeetha Yoganathan, Manohar Shroff, Carolina Gorodetsky

Neurology. 2025 Oct 7;105(7):e214126. Epub 2025 Sep 11

Abstract
DEAH-Box helicase 37 (DHX37) gene, encoding an RNA-helicase, is essential for ribosome biogenesis. Pathogenic variants in the DHX37 gene result in a spectrum of ribosomopathies ranging from neurodevelopmental disorders with possible brain, vertebral, and/or cardiac anomalies (NEDBAVC syndrome, OMIM #618731) as well as disorders of sex development. Here, we describe a young boy with DHX37-related neurodevelopmental disorder with clinical and imaging findings masquerading as cerebral palsy. A 7.5-year-old boy presented with global developmental delay and generalized chorea of 6 months duration. He was born at 37 weeks gestation after an uneventful pregnancy with a birth weight of 2668 g. He had primary microcephaly and intractable epilepsy from infancy. Examination revealed microcephaly, spastic quadriparesis, generalized choreoathetosis and dystonia. MRI of the brain revealed T2-weighted hyperintensity in bilateral corticospinal tracts, posterior limb of the internal capsule (PLIC), corona radiata, external capsule, periventricular and deep white matter, as well as subcortical cysts. Diffusion-weighted images showed high signal in bilateral corticospinal tract and PLIC. As there were red flags pointing away from cerebral palsy such as primary microcephaly, refractory seizures, late-onset movement disorder, and persistent high signal on diffusion-weighted imaging, whole genome sequencing (WGS) was sent. WGS revealed a homozygous variant c.2417G>A (p.Ser806Asn) in the DHX37 gene. He was managed with antiseizure medications and clonazepam. DHX37-related neurodevelopmental disorder should be included in the differential for cerebral palsy mimic as affected children have global developmental delay, primary microcephaly, seizures, and movement disorders and thus may masquerade as sequel of hypoxic ischemic encephalopathy.
PMID: 40934457

18.Sexual rights for adolescents with cerebral palsy and complex communication needs: Towards an intersectional and equitable framework

Sandrine Detandt

Dev Med Child Neurol. 2025 Sep 11. Online ahead of print

Abstract
No abstract available
PMID: 40932042

19.Communication about sexuality for adolescents with cerebral palsy and complex communication needs: A scoping review with framework synthesis

Megan Walsh, Susan M Sawyer, Joanne M Watson, Amie O'Shea, Georgia Cranko, Chris M Pacheco, Jacinta Pennacchia, Kate L M Anderson

Dev Med Child Neurol. 2025 Sep 10. Online ahead of print

Aim: To understand communication about sexuality for adolescents with cerebral palsy (CP) and complex communication needs.
Method: We systematically searched primary research on adolescents aged 10 to 24 years with CP and/or complex communication needs. We coded the primary evidence against themes derived from a theoretical framework analysis. Consumer research partners were involved throughout.
Results: Most of the 16 identified papers described adolescents with CP who could speak. While these adolescents engaged in some discussions with peers about sexuality, they also reported an absence of desired communication with peers and health professionals. The evidence about adolescents with complex communication needs centred on communication with teachers and parents or carers, and on vulnerability to abuse and socially appropriate masturbatory behaviours, rather than positive aspects of sexuality.
Interpretation: Given the complexity of their disabilities, adolescents with CP and complex communication needs probably require support to understand and express themselves as sexual and gendered beings. Our findings reveal a sexuality evidence base that fails to address the needs of adolescents with CP during this critical life phase, emphasizing the need for more inclusive, communication-aware sexuality research.
PMID: 40931485

20.Validation of the Croatian Visual Function Classification System and subtype-specific differences in cerebral palsy

Ana Katušić, Sonja Alimović, Andrea Paulik

Int J Rehabil Res. 2025 Sep 10. Online ahead of print

Abstract
The Visual Function Classification System (VFCS) provides a standardised framework for grading visual functioning in children with cerebral palsy (CP). This study evaluated the reliability and construct validity of the Croatian VFCS, and its ability to distinguish visual functioning across CP subtypes and functional classifications. Ninety-five children with CP (mean age: 11.8 years, range: 4–18) were assessed using VFCS, Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and Communication Function Classification System (CFCS). Reliability was tested using quadratic weighted kappa and intraclass correlation coefficients (ICCs); differences across CP types with the Kruskal-Wallis, and construct validity with Spearman correlations. The Croatian VFCS showed excellent interrater ($\kappa = 0.87$) and intrarater reliability ($\kappa = 0.92$), with ICCs greater than 0.90. VFCS levels differed significantly by CP subtype ($\chi^2 = 8.30$, $P = 0.016$), with preliminary evidence suggesting that unilateral spastic CP may be associated with better visual function than bilateral spastic or dyskinetic CP. Moderate correlations with CFCS ($\rho = 0.557$), MACS ($\rho = 0.392$), and GMFCS ($\rho = 0.308$) revealed clinically relevant divergences between visual and motor abilities. The Croatian VFCS is a reliable, valid, and clinically sensitive tool. This study provides preliminary evidence of its discriminative utility across CP subtypes and supports integrating VFCS into multidisciplinary assessment and individualised rehabilitation planning.
PMID: 40926749

21.Spastic cerebral palsy and quality of life in children aged 6–12 years: exploring key associated factors

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Background: Children with cerebral palsy (CP) may experience epilepsy and challenges with movement, posture, cognition, and musculoskeletal development, which can impact their quality of life (QOL). In this study, we investigated the relationship between demographic and clinical variables as well as QOL in children with spastic CP.
Methods: Children aged 6 to 12 years with CP who were followed-up at our tertiary center were included in this cross-sectional study, regardless of the cause. They were categorized into groups based on their gestational age, motor function levels, accompanying conditions such as epilepsy and intellectual disability, and demographic variables, including mothers' education and income levels. Subsequently, the QOL scores of these groups were compared. Among the 9–12 age group, those with sufficient intellectual capacity completed the QOL questionnaire by both the mothers and patients themselves. The Children's Sleep Habits Questionnaire (CSHQ) was evaluated and compared with the QOL scores of the patients.
Results: A total of 71 patients were included in the study (42 males, 59%). Children whose mothers were more educated and had higher in income level, who were ambulatory with hemiplegia, and did not have epilepsy had significantly better QOL scores. Those with better CSHQ scores were found to have significantly better QOL scores. Additionally, the responses of mothers and patients within the 9–12 age group were highly compatible.
Conclusion: Children with CP face challenges impacting their daily lives and overall QOL. Our study identified factors linked to the QOL of children with spastic CP and showed that their integration into CP management could enhance their well-being.
PMID: 40925037

22.Functional Connectivity of Hippocampal Circuits and Visual Memory Function in Children and Adolescents With Perinatal Stroke

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Abstract
Perinatal stroke is a vascular injury occurring early in life, often resulting in motor deficits (hemiplegic cerebral palsy/HCP). Comorbidities may also include poor neuropsychological outcomes, such as deficits in memory. Previous studies have used resting state functional MRI (fMRI) to demonstrate that functional connectivity (FC) within hippocampal circuits is associated with memory function in typically developing controls (TDC) and in adults after stroke, but this is unexplored in perinatal stroke. Investigating links with visual memory function has the potential to inform prognosis and personalized cognitive rehabilitation strategies. This study aimed to quantify FC within hippocampal circuits of children and adolescents with perinatal stroke and associations with visual memory. We hypothesized that FC would differ between participant groups (AIS, PVI, TDC) and hemispheres (left vs. right stroke), and would correlate with visual memory function. Participants aged 6–19 years with HCP and MRI-confirmed unilateral perinatal stroke (n = 30 arterial ischemic stroke [AIS], n = 38 periventricular venous infarction [PVI]) were recruited through the Alberta Perinatal Stroke Project and compared to n = 43 TDC. Resting fMRI volumes were processed to compute FC values between memory-related seeds using a standard pipeline in the CONN toolbox. Hemispheric and group differences in FC were examined. A subset of stroke participants (n = 46) completed visual memory testing via CNS Vital Signs. Partial correlations assessed associations between FC and visual memory function, factoring out age. We found hemispheric differences in FC within each group. Participants with left perinatal stroke showed greater FC between the hippocampus and lateral prefrontal cortex in the lesioned compared to non-lesioned hemisphere. TDCs had higher hippocampal FC when compared to the lesioned hemisphere of stroke groups. For participants with right hemisphere stroke, associations were observed between hippocampal FC and visual memory function. We describe differences in bilateral hippocampal functional connectivity in children and adolescents with perinatal stroke that are associated with visual memory function. Our findings suggest that developmental plasticity may occur in the non-lesioned hippocampus after perinatal stroke. These findings may inform our understanding of how visual memory function is affected after early unilateral brain injury and facilitate the development of novel therapies for individuals affected by perinatal stroke.
PMID: 40916901

Prevention and Cure

23.Riboflavin (Vitamin B2) Accumulation Modulates Neuronal Cellular Homeostasis in Typical Brain Development and Cerebral Palsy

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Abstract
The developing brain requires high energy demands and metabolic efforts to regulate oxidative stress and myelination. Early insults cause mitochondrial dysfunction and compromise these pathways, potentially leading to cerebral palsy (CP), a severe and incurable neurological disorder that begins in childhood. Through a rodent preclinical study, we demonstrated that vitamin B2 (riboflavin), administered at a high dose (100 mg/kg), is accumulated in healthy (B2C) or paralytic (B2CP) brains and participates in neurodevelopment. Redox homeostasis was maintained in B2C through decreased malondialdehyde and carbonyls and increased glutathione-S-transferase activity. In B2CP rodents, there was a reduction in carbonyls and increased superoxide dismutase activity. Mitochondrial morphometric analysis suggests that riboflavin treatment increases biogenesis in controls and reduces mitochondrial deformation in CP. Ultrastructural analysis revealed increased myelin sheath thickness in B2C. Additionally, myelin figure formation and mitochondrial and axonal disintegration in CP were reduced by B2. Our evidence supports vitamin B2 accumulation as a beneficial mechanism to support energy homeostasis and mitochondrial demands that occur during typical neurodevelopment or in the face of CP.
PMID: 40938477

24.Hypertensive disorders of pregnancy and childhood neurodevelopment: A systematic review and meta-analysis

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Background: Hypertensive disorders of pregnancy may be associated with an increased risk of adverse neurodevelopmental outcomes for the child, though no recent comprehensive meta-analyses exist. The aim of this study was to conduct a systematic review and meta-analysis examining the association between hypertensive disorders of pregnancy and child neurodevelopmental disabilities, intelligence, and educational outcomes.
Methods and findings: A search was conducted of MEDLINE, CINAHL, Web of Science, and PsycINFO databases from inception until 18 September 2024. Reference lists of included papers were also screened. Observational studies and secondary analyses of randomized trials reporting neurodevelopmental, cognitive, or educational outcomes for children born following hypertensive disorders of pregnancy against a reference population (unaffected pregnancies) were included. Two reviewers independently screened records, extracted data, and assessed quality of studies using Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Studies reporting similar outcomes were pooled using a random-effects meta-analysis model. Outcomes included autism, attention-deficit/hyperactivity disorder, cerebral palsy, global developmental delay, intellectual disability, intelligence quotient, and educational attainment. Results were reported as odds ratios (OR) or mean difference (MD) with corresponding 95% confidence intervals (CI). After screening 13,419 records, 121 studies reporting outcomes of 29,649,667 offspring were included. We included 85 cohort studies, 30 case-control studies, four cross-sectional studies, and two secondary analyses of randomized trials. Compared with unaffected pregnancies, hypertensive disorders of pregnancy were associated with an increased unadjusted likelihood of autism spectrum disorder (OR 1.65 [95% CI 1.49, 1.83]), attention-deficit/hyperactivity disorder (OR 1.27 [95% CI 1.21, 1.33]), intellectual disability (OR 1.77 [95% CI 1.31, 2.38]), global developmental delay (OR 1.77 [95% CI 1.21, 2.59]), and reduced mean intelligence (MD -2.20 [95% CI -3.35, -1.06]). Associations between hypertension and autism spectrum disorder and global developmental delay were no longer significant after adjusting for gestational age and birthweight. Results for intelligence quotient remained significant when adjusting for birthweight, but not gestational age. Adjusted analyses for attention-deficit/hyperactivity disorder and intellectual disability could not be performed due to a lack of suitable studies. In sensitivity analyses, results were unchanged after exclusion of papers at high risk of bias. This study is limited by a lack of constituent papers which adjusted for confounding and mediating factors, a high amount of heterogeneity among included studies, and possible publication bias for some outcomes.
Conclusions: Hypertensive disorders of pregnancy are potentially associated with adverse neurodevelopmental and cognitive outcomes among affected offspring. While the mechanisms driving these associations are not clear, these results highlight a group of children that will benefit from early intervention and support to improve their neurodevelopmental outcomes.
PMID: 40929171

25.Perinatal Arterial Ischemic Stroke in Monochorionic Twins: A Retrospective Observational Single-Center Cohort Study

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Background: Monochorionic twins, characterized by placental sharing and vascular anastomoses, carry a high risk of brain injury, including perinatal arterial ischemic stroke (PAIS). However, the pathophysiology and timing-related risk factors of PAIS remain unclear.
Methods: Retrospective cohort of all monochorionic twins with neuroimaging-confirmed PAIS born from 2005 to 2024 and evaluated at a Dutch national referral center. PAIS timing was classified as presumed antenatal, direct perinatal, or postnatal onset. Risk factors and neurodevelopmental outcomes, including cerebral palsy and cognitive impairment, were assessed.
Results: Eighteen cases of PAIS were identified among 1183 twin pairs born <35 weeks' gestation (1.5%). Mean gestational age at birth was 29.4 weeks (95% CI, 28.3–31.5), and mean birth weight was 1258 (95% CI, 1062–1453) grams. Pregnancy complications were identified in 89%: twin-to-twin transfusion syndrome (n = 13), twin anemia polycythemia sequence (n = 1), and single fetal demise (n = 2). In twin-to-twin transfusion syndrome/twin anemia polycythemia sequence, PAIS was diagnosed in the recipient twin in 12 of 14 (86%) cases. Regarding stroke onset, 6 occurred antenatally, 7 direct perinatally, and 5 occurred in the postnatal period. Stroke patterns involved the middle cerebral artery (anterior, posterior, or main branch) in 10 of 18 (56%); anterior cerebral artery in 1 of 18 (6%), perforator arteries arising from middle cerebral artery, or anterior cerebral artery in 7 of 18 (38%); and posterior cerebral artery in 1 of 18 (6%). Among 7 infants with main branch middle cerebral artery stroke, 2 died in the fetal or neonatal period, and all 4 with a follow-up assessment developed unilateral spastic cerebral palsy. Among 6 infants with perforator stroke and follow-up, 2 had hemiparesis at 24 months corrected age.
Conclusions: PAIS in monochorionic twins predominantly affects the recipient twin and can occur in the antenatal, direct perinatal, or postnatal period, with variable stroke patterns and outcomes. We recommend dedicated fetal and postnatal neuroimaging in complicated preterm-born monochorionic twins to detect PAIS and allow early rehabilitation therapy.
PMID: 40927822

26.Standardizing early cerebral palsy detection in high-risk infants: reducing age at diagnosis through a quality improvement initiative

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Objective: To screen high-risk infants for CP in a level IV NICU and high-risk infant follow-up (HRIF) clinic.
Study design: By using quality improvement methodology, we implemented the General Movement Assessment (GMA) and Hammersmith Infant Neurological Examination (HINE) to screen for CP and lower age at diagnosis. Main balancing measures included no-show rates.
Results: Within the first year, 89% of infants had a GMA in the NICU, 100% in HRIF and 87% had a HINE in HRIF. Median age at diagnosis decreased from 18.5 months adjusted [16.7, 19.4] in 2021 to 7.5 months [5.9, 14.4; p = 0.01] in 2022 and 8.9 months [6.6, 12.2; p = 0.01] in 2023. No-show rates increased in 2022 compared to 2021 (24% vs 17%, p = 0.02).
Conclusions: By implementing and continuously improving a standard process in the NICU and HRIF, we demonstrated a successful increase in screening for CP leading to a lower age at diagnosis sustained for two years.
PMID: 40925942

27.Clinical Phenotype, Predictors and Early Biomarkers of Dyskinetic Cerebral Palsy Prognosis

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Background: Dyskinetic cerebral palsy (DCP) is a severe subtype of cerebral palsy in which children often present substantial functional impairment and multiple comorbidities. Our knowledge of the clinical picture of DCP is limited and our understanding of which markers best predict later impairment is scarce. This study aims to describe the presentation of DCP and examine the value of gestational age (GA) and magnetic resonance imaging (MRI) findings as early markers of eventual DCP prognosis.
Methods: Data from 170 children with DCP were extracted from the Canadian Cerebral Palsy Registry. Participants were classified as preterm or full-term and were divided into two groups based on MRI results: (1) normal/nonspecific, white matter injury, watershed injury, focal insult, malformation and (2) deep grey matter injury, and near total grey matter injury. Pearson Chi-square analyses were carried out to examine how DCP-associated risk factors and comorbidities vary with GA and MRI findings.
Results: Most children with DCP are born at term (69%), experience severe motor impairments (70% with Gross Motor Function Classification System and 73% with Manual Ability Classification System Levels IV–V), and present more than one comorbidity (46%). GA is associated with neonatal encephalopathy, hyperbilirubinemia, perinatal adversity, higher Manual Ability Classification System level, epilepsy and deafness ($P < 0.01$, $P = 0.04$, $P < 0.01$, $P < 0.01$, respectively). MRI findings are associated with neonatal encephalopathy, and perinatal adversity ($P = 0.003$), but not motor and speech impairment or any of the DCP-associated comorbidities.
Conclusions: DCP is a severe form of CP affecting predominantly term-born infants. Relative to MRI findings, GA is a stronger predictor of eventual DCP prognosis.
PMID: 40913867