Cerebral palsy research news

Monday 31 May 2021

Cerebral Palsy Alliance is delighted to bring you this free weekly bulletin of the latest published research into cerebral palsy. Our organisation is committed to supporting cerebral palsy research worldwide - through information, education, collaboration and funding. Find out more at cerebralpalsy.org.au/our-research

Professor Nadia Badawi AM
Macquarie Group Foundation Chair of Cerebral Palsy

Subscribe to CP Research News

Interventions and Management

1. Effectiveness of the manual diaphragmatic stretching technique on respiratory function in cerebral palsy: A randomised controlled trial
Surussawadi Bennett, Wantana Siritaratiwat, Nittaya Tanrangka, Michael John Bennett, Jaturat Kanpittaya

Respir Med. 2021 May 19;184:106443. doi: 10.1016/j.rmed.2021.106443. Online ahead of print.

Background: Respiratory failure resulting from diaphragmatic muscle weakness is a major cause of long-term hospitalization in children with cerebral palsy (CP). Manual diaphragmatic stretching technique (MDST) can be directly applied to stretch diaphragmatic muscle and has been reported to improve respiratory function in patients with asthma and COPD. However, there have been no studies among CP. This study aimed to examine the effects of a six-week MDST course on respiratory function among CP. Methods: Fifty-three children with spastic CP were randomly assigned to experimental (n = 27) and control (n = 26) groups. The experimental group received MDST on non-consecutive days, three days per week for six weeks alongside standard physiotherapy (SDPT), while the control group received only SDPT. The outcome variables were diaphragmatic mobility, pulmonary function and chest wall expansion. Results: MDST significantly improved diaphragmatic mobility on both sides of the body, with a between-group difference of 0.97 cm (95% CI 0.55-1.39 cm, $p < 0.001$) for the right side and 0.82 cm (95% CI 0.35-1.29 cm, $p = 0.001$) for the left side. MDST significantly improved chest wall expansion at the xiphoid process and umbilical levels, with between-group differences of 0.57 cm (95% CI 0.12-1.20 cm, $p = 0.013$) and 0.87 cm (95% CI 0.31-1.43 cm, $p = 0.003$), respectively. There was no significant difference in pulmonary function testing between the groups. Conclusion: MDST could significantly improve diaphragmatic mobility, and lower and abdominal chest wall expansion, among children with CP. Therefore, MDST could be considered as an additional technique for physiotherapy programmes, to improve diaphragmatic function in spastic CP.

PMID: 34029936

2. Effect of Dance on Balance, Mobility, and Activities of Daily Living in Adults With Cerebral Palsy: A Pilot Study
Hee Joung Joung, Hye Kyung Yang, Yongho Lee

Front Neurol. 2021 May 7;12:663060. doi: 10.3389/fneur.2021.663060. eCollection 2021.

The age-related decline in motor function with respect to balance and mobility may hamper the activities of daily living, quality of life, and social participation. Despite the importance of managing secondary conditions leading to premature aging, the literature regarding appropriate physical activity for adults with cerebral palsy (CP) is still scarce. Dance forms have emerged as an effective physical activity that improves balance and mobility in individuals with neurological conditions and boosts social engagement. However, its effect on adults with CP has yet to be examined. This pilot study aimed to examine the long-term effect of dance on improving balance and mobility in adults with CP. This single-cohort study included 10

adults with CP. They attended two 90-min-long creative dance sessions per week for 12 weeks. The outcomes measured effects on balance, mobility, balance confidence, and level of functional independence. These measurements were obtained at pre-intervention, post-intervention, and the 3-month follow-up. Outcome data of pre- to post-intervention and pre-intervention to 3-month follow-up were analyzed and compared. Statistically significant differences were found in the pre- and post-intervention displacement of the center of pressure (CoP) in the eyes-opened (EO) condition, timed up and go test (TUG), and Berg Balance Scale (BBS), Dynamic Gait Index (DGI), and Korean-Activity of Balance Confidence (K-ABC) scores. Significant improvements were also observed for the CoP-EO, BBS, TUG, DGI, and K-ABC between the pre-intervention and 3-month follow-up assessments. However, there were no significant differences in the CoP in the eyes-closed condition and Korean modified Barthel Index score. Participants expressed enjoyment without any pain or fatigue. Our findings suggest that dance may have a positive impact in improving balance and mobility and may consequently contribute to healthy aging in adults with CP.

PMID: 34025566

3. More than 20 years of experience with Dega transiliac osteotomy in the treatment of dislocated hip joints in children with cerebral palsy
Błażej Pruszczyński, Marek Synder, Marek Drobniewski, Andrzej Borowski

J Pediatr Orthop B. 2021 May 20. doi: 10.1097/BPB.0000000000000872. Online ahead of print.

Objective: Cerebral palsy in children, which is the result of a nonprogressing damage to the central nervous system, causes motor and posture disorders that change with age. The level of child activity correlates with the hip dislocation risk. It most often affects nonwalking patients and those with tetraparesis or oblique pelvis. The aim of the study was to assess the effectiveness and clinical value of Dega pelvic osteotomy with accompanying directional femoral bone osteotomy after minimum of 20 years from surgery of patients with cerebral palsy. Methods: The conducted research was retrospective and concerned the children operated at our Hospital. The assessment was carried out in 346 children with spastic hip during the years 1993-2000. The inclusion criteria were applied: unilateral dislocation of the hip, the observation period of at least 20 years, pelvic osteotomy by Dega method and combined with varus derotation femur osteotomy. Results: The analysis involved fifteen patients. The follow-up period was minimum 20 years (20-27 years). The average migration percentage decreased from 88% down to 25%, and an improved range of mobility was observed in the operated joint after surgery. However, the range of mobility was again significantly reduced during the last control examination after a minimum of 20 years. In all hips, the degenerative joint disease was present. Conclusions: Pelvic transiliac osteotomy, according to Dega, with VDRO, ensures very effective correction of the deficit in femoral head coverage by the acetabulum in the upper, lateral and posterior parts. However, it does not prevent the development of the early degenerative disease of the joint.

PMID: 34028381

4. The influence of preoperative knee flexion contracture severity on short-term outcome of orthopedic surgery in ambulatory children with bilateral cerebral palsy
Evelina Pantzar-Castilla, Brian Po-Jung Chen, Freeman Miller, Jacques Riad

BMC Musculoskelet Disord. 2021 May 25;22(1):481. doi: 10.1186/s12891-021-04362-x.

Background: Indications and cutoff value of deformities to determine surgical procedures for flexed knee gait are not clear. The aim was to determine the influence of none or mild, and moderate preoperative knee flexion contracture on the improvement of gait after orthopedic surgery in children with bilateral cerebral palsy (CP). Methods: Inclusion criteria; bilateral CP, Gross Motor Function Classification System level I-III, and pre- and post operative-gait analysis. The 132 individuals identified were categorized into 2 groups based on the severity of knee flexion contracture (group 1: none or less than 11°; group 2: greater than or equal to 11°), and then matched according to the exact same soft tissue and/or bony orthopedic surgical procedures performed. The indication for surgery was to prevent progressive development of knee flexion contracture and stance phase flexed knee gait. Pre- and postoperative physical examination and gait analysis data were analyzed retrospectively. Results: Sixty (30 + 30) children, with mean age 10.6 years in each group, were included. The average follow-up time was 17 months. Gait Deviation Index (GDI) improved in group 1 from mean 66 (SD 19) to 74 (15), $p = 0.004$, and in group 2 from 60 (13) to 69 (15), $p = 0.001$. Knee flexion in stance improved in group 1 from 21.4 (16.1) to 12.1 (16.0) degrees, $p = 0.002$, and in group 2 from 32.2 (14.2) to 17.0 (15.9), $p = 0.001$. Step length improved in both groups, $p = 0.017$ and $p = 0.008$, respectively. Only in group 2 significant improvement was noted in walking speed, $p = 0.018$ and standing function, Gross Motor Function

Measure (GMFM-D), p = 0.001. Knee flexion contracture decreased in group 1 from mean 4.6 (5.3) to 2.1 (8.3) degrees, p = 0.071 and in group 2 from 17.2 (4.9) to 9.6 (9.3), p = 0.001. There was no statistical difference between groups in pre-post improvement of GDI or other variables, except GMFM-D. Conclusions: Relative mild to moderate preoperative knee flexion contracture does not influence the short-term improvement of gait after orthopedic surgery in children with bilateral CP.

PMID: 34034736

5. Add-on Home-Centred Activity-Based Therapy vs Conventional Physiotherapy in Improving Walking Ability at 6-Months in Children with Diplegic Cerebral Palsy: A Randomized Controlled Trial
Jyotindra Narayan Goswami, Naveen Sankhyan, Pratibha Singhi

Indian Pediatr. 2021 May 28;S097475591600332. Online ahead of print.

Background: Institutional physiotherapy as a standard of care for management of cerebral palsy (CP) has certain shortcomings, especially in resource-constrained settings. This is a proof-of-concept trial to evaluate the efficacy of individualized home-centered activity-based therapy in children with spastic diplegic CP. Design: Randomized controlled trial (open-label). Settings: Tertiary-care hospital with pediatric neurology services (July 2014 to July 2016). Participants: Consecutive sample of 59 children (5-12yrs) with spastic diplegic CP (Gross Motor Function Classification System scores II - III) without fixed lower-limb contractures, illnesses impeding physiotherapy or history of recent botulinum toxin injection/surgery were recruited. Procedure: Children were randomized to Intervention or Control arms. Their 6-minute-walk Test (6MWT) scoring and clinical examination were performed at baseline, 3 and 6 months. Children in Intervention Arm (n=30) were prescribed parent-supervised home-centered activity-based therapy (walking, standing, squatting, climbing up/downstairs, kicking a ball, dancing, riding a tricycle/bicycle) in addition to their institutional physiotherapy. Children in Control Arm (n=29) were prescribed ongoing institutional physiotherapy alone. Logbooks, home videos and telephonic follow-ups were used to ensure compliance. Main outcome measures: Comparison of the mean change in 6MWT scores at 6 months (from baseline) between the two groups. Results: Median (IQR) change in 6MWT scores at 6 months (from baseline) in the Intervention and Control arms were 3.5 (-5.3, 9) m and 3 (-7.8, 6.3) m. Conclusion: Adjunct home-centered activity-based therapy was safe and feasible, but did not result in appreciable gains over 6 months.

PMID: 34047715

6. Effectiveness of powered exoskeleton use on gait in individuals with cerebral palsy: A systematic review
Lucinda Rose Bunge, Ashleigh Jade Davidson, Benita Roslyn Helmore, Aleksandra Daniella Mavrandonis, Thomas David Page, Tegan Rochelle Schuster-Bayly, Saravana Kumar

PLoS One. 2021 May 26;16(5):e0252193. doi: 10.1371/journal.pone.0252193. eCollection 2021.

Background: Cerebral palsy (CP) is a leading cause of childhood disability. The motor impairments of individuals with CP significantly affect the kinematics of an efficient gait pattern. Robotic therapies have become increasingly popular as an intervention to address this. Powered lower limb exoskeletons (PoLLE) are a novel form of robotic therapy that allow the individual to perform over-ground gait training and yet its effectiveness for CP is unknown. Purpose: To determine the effectiveness of PoLLE use on gait in individuals with CP. Method: A systematic search of eight electronic databases was conducted in March 2020. Studies included children (0-18 years) and or adults (18+ years) diagnosed with CP who used a PoLLE for gait training. This review was conducted and reported in line with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement, with the methodology registered with PROSPERO (CRD42020177160). A modified version of the McMaster critical review form for quantitative studies was used to assess the methodological quality. Due to the heterogeneity of the included studies, a descriptive synthesis using the National Health & Medical Research Council (NHMRC) FORM framework was undertaken. Results: Of the 2089 studies screened, ten case series and three case studies met the inclusion criteria highlighting the current evidence base is emerging and low level. A range of PoLLEs were investigated with effectiveness measured by using a number of outcome measures. Collectively, the body of evidence indicates there is some consistent positive evidence on the effectiveness of PoLLE in improving gait in individuals with CP, with minimal adverse effects. While this is a positive and encouraging finding for an emerging technology, methodological concerns also need to be acknowledged. Conclusion: With rapidly evolving technology, PoLLEs could play a transformative role in the lives of people impacted by CP. Ongoing research is required to further strengthen the evidence base and address current methodological concerns.

PMID: 34038471

7. Dental health status and hygiene in children with cerebral palsy: A matched case-control study
Samah K Aburahma, Asmaa Mhanna, Saba Al-Mousa, Jowan Al-Nusair, Rola Al Habashneh

Int J Paediatr Dent. 2021 May 22. doi: 10.1111/ipd.12799. Online ahead of print.

Background: Children with cerebral palsy (CP) are at risk for oral pathology and parafunctional habits, and are reliant on caregivers for oral hygiene. Aim: To evaluate oral hygiene habits and oral examination findings among a group of children with CP and a healthy age- and gender-matched control group. Design: A comparative, cross-sectional study, consisting of a questionnaire component and a standard dental examination component, each applied to both groups. Results: Eighty-three children with CP and 84 healthy children were included. Parents of children with CP were more likely to be of low educational level and lack a professional line of occupation ($P < .05$). Children with CP were less likely to be responsible for oral hygiene maintenance, adhere to toothbrushing, or receive procedural dental care ($P < .001$). Food packing and drooling were significantly more likely in children with CP. Malocclusion type III was more prevalent among children with CP, as was higher gingival index and gingival enlargement index-horizontal component ($P < .001$). There were no differences in caries experience between the CP and control groups. Conclusions: Children with CP have suboptimal oral hygiene habits, limited access to procedural dental care, higher parafunctional habits, and increased periodontal pathology.

PMID: 34022090

8. Risks and Benefits of Adenotonsillectomy in Children With Cerebral Palsy With Obstructive Sleep Apnea: A Systematic Review
Christopher End, Evan J Propst, Sharon L Cushing, Nicole K McKinnon, Indra Narang, Reshma Amin, Jackie Chiang, Suhail Al-Saleh, Clyde Matava, Nikolaus E Wolter

Review Laryngoscope. 2021 May 25. doi: 10.1002/lary.29625. Online ahead of print.

Objectives/hypothesis: Assess the risks and benefits of adenotonsillectomy (AT) for obstructive sleep apnea (OSA) in children with cerebral palsy (CP). Study design: Systematic review. Methods: We conducted a systematic review of Medline, Embase, and Cochrane Central Registry from 1946 to 2021. Broad search concepts included cerebral palsy, pediatric, tonsillectomy/adenoidectomy, and sleep. Additional articles were identified by searching reference lists. Studies on the safety and efficacy of AT for OSA management in children with CP were included. Results: Fifteen articles met inclusion criteria. Articles were classified into one or more of four themes: intraoperative risk ($n = 1$), postoperative risk ($n = 3$), postoperative care requirements ($n = 6$), and surgical outcomes ($n = 7$). No intraoperative anesthetic complications were reported. Postoperatively, respiratory complications including pneumonia were common and necessitated additional airway management. Following AT, children with CP required close postoperative observation, experienced increased lengths of stay, and had increased odds of unplanned intensive care unit (ICU) admission. Benefits following AT were improvement in OSA as measured by a reduction in obstructive apnea-hypopnea index (OAHI) as well as improved quality of life in some; however, many patients went on to require tracheostomy due to persistent OSA. Conclusions: Children with CP who undergo AT have a significant risk of developing a postoperative respiratory complication. Realistic counselling of families around increased perioperative risks in this population is imperative and close postoperative monitoring is critical. Many children will obtain a reduction in OAHI, but additional surgical management is often required, including tracheostomy. Further research is needed to determine the best management strategy for OSA in children with CP. Laryngoscope, 2021.

PMID: 34032299

9. Expressed Emotion in Families of Children With and Without Autism Spectrum Disorder, Cerebral Palsy and Down Syndrome: Relations with Parenting Stress and Parenting Behaviors
Lana E De Clercq, Peter Prinzie, Petra Warreyn, Bart Soenens, Lisa M Dieleman, Sarah S W De Pauw

J Autism Dev Disord. 2021 May 22. doi: 10.1007/s10803-021-05075-9. Online ahead of print.

This study examined the family emotional climate as assessed by Five Minute Speech Samples and the relation with parenting stress and parenting behaviors among parents of children (6-17 years, 64.7% boys) with autism spectrum disorder, cerebral palsy, Down syndrome, and without any known disability (n = 447). The large majority of parents (79%) showed low levels of Expressed Emotion, an indicator of a positive family climate. In all groups, more Emotional Over-involvement, more Criticism and fewer expressions of Warmth were associated with higher levels of parenting stress. Across groups, Emotional Over-involvement was related to more autonomy-supportive parenting, Criticism to more psychologically controlling and overreactive parenting, and Warmth was associated with more responsive and less psychologically controlling and overreactive parenting.

PMID: 34021833

10. Can Children With Perinatal Stroke Use a Simple Brain Computer Interface?
Zeanna Jadavji, Jack Zhang, Brett Paffrath, Ephrem Zewdie, Adam Kirton

Stroke. 2021 May 27;STROKEAHA120030596. doi: 10.1161/STROKEAHA.120.030596. Online ahead of print.

Background and purpose: Perinatal stroke is the leading cause of hemiparetic cerebral palsy resulting in lifelong disability for millions of people worldwide. Options for motor rehabilitation are limited, especially for the most severely affected children. Brain computer interfaces (BCIs) sample brain activity to allow users to control external devices. Functional electrical stimulation enhances motor recovery after stroke, and BCI-activated functional electrical stimulation was recently shown to improve upper extremity function in adult stroke. We aimed to determine the ability of children with perinatal stroke to operate a simple BCI. Methods: Twenty-one children with magnetic resonance imaging-confirmed perinatal stroke (57% male, mean [SD] 13.5 [2.6] years, range 9-18) were compared with 24 typically developing controls (71% male, mean age [SD] 13.7 [3.7] years, range 6-18). Participants trained on a simple EEG-based BCI over 2 sessions (10 trials each) utilizing 2 different mental imagery strategies: (1) motor imagery (imagine opening and closing of hands) and (2) goal oriented (imagine effector object moving toward target) to complete 2 tasks: (1) drive a remote controlled car to a target and (2) move a computer cursor to a target. Primary outcome was Cohen Kappa with a score >0.40 suggesting BCI competence. Results: BCI performance was comparable between stroke and control participants. Mean scores were 0.39 (0.18) for stroke versus 0.42 (0.18) for controls (t [42]=0.478, P=0.94). No difference in performance between venous (M=0.45, SD=0.29) and arterial (M=0.34, SD=0.22) stroke (t[82]=1.89, P=0.090) was observed. No effect of task or strategy was observed in the stroke participants. Over 90% of stroke participants demonstrated competency on at least one of the 4 task-strategy combinations. Conclusions: Children with perinatal stroke can achieve proficiency in basic tasks using simple BCI systems. Future directions include exploration of BCI-functional electrical stimulation systems for rehabilitation for children with hemiparesis and other forms of cerebral palsy.

PMID: 34039029

11. On the road again! Tricycle adaptation with the design of a universal rig
Elizabeth Hoskin, Michael Fader, Andrew Gowthorpe, Ariana Alvarino, T Claire Davies

Assist Technol. 2021 May 24. doi: 10.1080/10400435.2021.1934607. Online ahead of print.

Cerebral palsy is the most common childhood disability impacting motor function. The International Classification of Functioning, Disability and Health defines outcomes that should be achieveable within the Activities and Participation domain. However, many children with cerebral palsy have significant difficulties in achieving activity goals within a typical recreational environment. Despite the well documented benefits of cycling for persons with cerebral palsy for example, it is often difficult to access commercially available adaptive tricycles due to prohibitive costs and varying needs. Even commercially available adaptive tricycles sometimes need to be customised. This paper outlines the design and implementation of a custom tricycle adaptation for a teenager with cerebral palsy, who was previously unable to complete a pedal rotation on any of the many adaptive tricycles she tried. The first phase of the project was the design and implementation of a 'test rig' system that allowed different tricycle adaptations to be tested with the client, and could be used with any client. The second stage included two iterations of the design and implementation of adaptations to the tricycle. The final modifications enabled the client to ride independently. Challenges, successes, and recommendations for helping similar clients gain access to cycling are highlighted.

PMID: 34029175

12. Epidemiology of cerebral palsy in low- and middle-income countries: preliminary findings from an international multi-centre cerebral palsy register
Israt Jahan, Mohammad Muhit, Denny Hardianto, Francis Laryea, Amir Banjara Chhetri, Hayley Smithers-Sheedy, Sarah McIntyre, Nadia Badawi, Gulam Khandaker

Dev Med Child Neurol. 2021 May 24. doi: 10.1111/dmcn.14926. Online ahead of print.

Aim: To describe the epidemiology of cerebral palsy (CP) in children from low- and middle-income countries (LMICs) using data from the Global Low- and Middle-Income Country CP register (GLM-CPR). Method: The GLM-CPR is a multi-country initiative that combines and compares data from children with CP (<18y) in LMICs. Children with CP are registered after detailed neurodevelopmental assessment by a multidisciplinary medical team using a harmonized protocol. Data are collected on agreed core variables. Descriptive analyses are completed to report findings from participating countries. Results: Between January 2015 and May 2019, 2664 children were recruited from Bangladesh, Nepal, Indonesia, and Ghana (mean age [SD] at assessment: 7y 8mo [4y 8mo], 95% confidence interval 7y 6mo-7y 11mo; male [n=1615] 60.6%, female [n=1049] 39.4%). Overall, 86.6% children acquired CP prenatally and perinatally (e.g. preterm birth, birth asphyxia, neonatal encephalopathy). Median age at CP diagnosis was 3 years. Moreover, 79.2% children had spastic CP and 73.3% were classified in Gross Motor Function Classification System levels III to V. Notably, 47.3% of children never received rehabilitation services (median age at receiving rehabilitation services was 3y; 12.7% received assistive devices) and 75.6% of school-age children had no access to education. Interpretation: Population-based data show that the proportion of severe cases of CP is very high in LMICs. Children with CP in LMICs lack access to rehabilitation and educational services and a large proportion of children have potentially preventable risk factors, for example, birth asphyxia and neonatal infections. Delayed diagnosis, severe motor impairments, and lack of rehabilitation in most children call for urgent action to identify preventive opportunities and promote early diagnosis and intervention for children with CP in LMICs.

PMID: 34031872

13. Motor imagery in congenital hemiplegia: Impairments are not universal
Jacqueline Williams, Ian Fuelscher, Christian Hyde

Res Dev Disabil. 2021 May 23;114:103991. doi: 10.1016/j.ridd.2021.103991. Online ahead of print.

Background: Motor imagery (MI) training may benefit children with congenital hemiplegia, but reports on MI ability are mixed. This study considered individual patterns of performance to better understand MI ability in children with hemiplegia. Method: Twenty children with hemiplegia (7-13 years; 10 with right hemiplegia), completed a MI task, IQ estimate and functional tests. Children with hemiplegia scoring above chance on the MI task were compared to a group of age-matched peers. The performance patterns of those scoring below chance were considered individually. Results: Three children with right hemiplegia were excluded due to low IQ. Seven of 10 children with left hemiplegia and three of seven with right hemiplegia performed MI at an equivalent level to peers without hemiplegia. The seven children with hemiplegia who scored significantly below chance scored lower on functional tests, but differences here failed to reach an adjusted significance level. Four of the seven appeared engaged in MI, but performed very poorly. The remaining three had unique performance patterns explored in more detail. Conclusion: Motor imagery deficits are not universally observed in children with congenital hemiplegia and individual performance should be examined before completing group analyses. Recommendations for exclusions and reporting in future studies are made.

PMID: 34029886

14. Hyperbilirubinemia and Asphyxia in Children With Dyskinetic Cerebral Palsy
Arushi Gahlot Saini, Naveen Sankhyan, Prahbhjot Malhi, Chirag Ahuja, Niranjan Khandelwal, Pratibha Singhi

Pediatr Neurol. 2021 Mar 4;120:80-85. doi: 10.1016/j.pediatrneurol.2021.02.002. Online ahead of print.

Background: We aimed to study the clinical, etiologic, and radiological characteristics in children with dyskinetic cerebral palsy (DCP) and to compare the etiologic subtypes of hyperbilirubinemia and perinatal asphyxia. Methods: This is a cross-

sectional, observational study that enrolled consecutive children with DCP, aged one to 14 years. Results: Sixty-five children with DCP were evaluated. Most children were boys (77%, n = 50), and term gestation (80%, n = 52). Presenting concerns were global developmental delay (97%, n = 63) and involuntary movements (60%, n = 39). Hyperbilirubinemia (66%, n = 43) and perinatal asphyxia (29%, n = 19) were the most important causes. The majority (83%, n = 54) of children were severely disabled (level V and IV). The hyperbilirubinemia group had significant motor delay (63% vs 37%, P = 0.03) and upward gaze palsy (69.7% vs 31.5%, P = 0.005) when compared with the perinatal asphyxia group. Hyperbilirubinemia significantly involved pallidi (86% vs 10% P = 0.0001) and subthalamic nucleus (26% vs none, P = 0.01), whereas asphyxia significantly involved the putamen (58% vs none, P = 0.0001), thalamus (63% vs none, P = 0.0001), and periventricular white matter (79% vs 19%, P = 0.0001). Conclusions: DCP is the dominant type of cerebral palsy seen in term-born babies with severe dystonia, developmental delay, and motor impairment. Hyperbilirubinemia is the major cause of DCP in the study. Hyperbilirubinemia is associated with motor delay, upward gaze palsy, prominent dystonia, and involvement of globus pallidi and subthalamic nuclei.

PMID: 34023554

15. The role of brain territorial involvement and infection/inflammation in the long-term outcome of neonates with arterial ischemic stroke: A population-based cohort study
Eszter Vojcek, Agnes Jermendy, Anna M Laszlo, Rozsa Graf, Gabor Rudas, Marianne Berenyi, Istvan Seri

Early Hum Dev. 2021 May 17;158:105393. doi: 10.1016/j.earlhumdev.2021.105393. Online ahead of print.

Background: Neonatal arterial ischemic stroke (NAIS) carries the risk of significant long-term neurodevelopmental burden on survivors. Aims: To assess the long-term neurodevelopmental outcome of term neonates diagnosed with NAIS and investigate the associations among brain territorial involvement on MRI, clinical risk factors and neurodevelopmental outcomes. Study design: Population-based cohort study. Subjects: Seventy-nine term neonates with NAIS confirmed by MRI born between 2007 and 2017. Outcome measures: Long-term neurodevelopmental outcome assessed using the Bayley Scales of Infant Development-II, the Brunet-Lézine test and the Binet Intelligence scales-V. Results: Follow-up was available in 70 (89%) of the subjects enrolled, at a median age of 60 months [IQR: 35-84]. Normal neurodevelopmental outcome was found in 43% of the patients. In a multivariable model, infants with main MCA stroke had an increased risk for overall adverse outcome (OR: 9.1, 95% CI: 1.7-48.0) and a particularly high risk for cerebral palsy (OR: 55.9, 95% CI: 7.8-399.2). The involvement of the corticospinal tract without extensive stroke also increased the risk for cerebral palsy/fine motor impairment (OR: 13.5, 95% CI: 2.4-76.3). Multiple strokes were associated with epilepsy (OR: 9.5, 95% CI: 1.0-88.9) and behavioral problems (OR: 4.4, 95% CI: 1.1-17.5) and inflammation/infection was associated with cerebral palsy (OR: 9.8, 95% CI: 1.4-66.9), cognitive impairment (OR: 9.2, 95% CI: 1.8-47.8) and epilepsy (OR: 10.3, 95% CI: 1.6-67.9). Conclusions: Main MCA stroke, involvement of the corticospinal tract, multiple strokes and inflammation/infection were independent predictors of adverse outcome, suggesting that the interplay of stroke territorial involvement and clinical risk factors influence the outcome of NAIS.

PMID: 34034089

16. Neurodevelopmental outcome following hypoxic ischaemic encephalopathy and therapeutic hypothermia is related to right ventricular performance at 24-hour postnatal age
Regan E Giesinger, Amr I El Shahed, Michael P Castaldo, Adrianne R Bischoff, Vann Chau, Hilary E A Whyte, Afif Faisal El-Khuffash, Luc Merten, Patrick J McNamara

Arch Dis Child Fetal Neonatal Ed. 2021 May 27;fetalneonatal-2020-321463. doi: 10.1136/archdischild-2020-321463. Online ahead of print.

Objective: Our aim was to determine whether right ventricular (RV) dysfunction at 24-hour postnatal age predicts adverse developmental outcome among patients with hypoxic ischaemic encephalopathy (HIE) undergoing therapeutic hypothermia (TH). Design: Neonates≥35 weeks with HIE/TH were enrolled in a physiological study in the neonatal period (n=46) and either died or underwent neurodevelopmental follow-up at 18 months (n=43). The primary outcome was a composite of death, diagnosis of cerebral palsy or any component of the Bayley Scores of Infant Development III<70. We hypothesised that tricuspid annulus plane systolic excursion (TAPSE) <6 mm and/or RV fractional area change (RV-FAC) <0.29 would predict adverse outcome. Results: Nine patients died and 34 patients were followed up at a mean age of 18.9±1.4 months. Both indices of RV systolic performance were abnormal in 15 (35%) patients, TAPSE <6 mm only was abnormal in 4 (9%) patients and RV -FAC <0.29 only was abnormal in 5 (12%) patients (19 had with normal RV function). Although similar at admission, neonates with RV dysfunction had higher cardiovascular and neurological illness severity by 24 hours than those without and severe

MRI abnormalities (70% vs 53%, p=0.01) were more common. On logistic regression, TAPSE <6 mm (OR 3.6, 95% CI 1.2 to 10.1; p=0.017) and abnormal brain MRI [OR 21.7, 95% CI 1.4 to 336; p=0.028) were independently associated with adverse outcome. TAPSE <6 mm predicted outcome with a 91% sensitivity and 81% specificity. Conclusions: The role of postnatal cardiovascular function on neurological outcomes among patients with HIE who receive TH merits further study. Quantitative measurement of RV function at 24 hours may provide an additional neurological prognostic tool.

PMID: 34045280

17. Neurodevelopmental outcomes of singleton large for gestational age infants <29 weeks' gestation: a retrospective cohort study
Deepika Rustogi, Anne Synnes, Belal Alshaikh, Shabih Hasan, Christine Drolet, Edith Masse, Prashanth Murthy, Prakesh S Shah, Kamran Yusuf, Canadian Neonatal Network and the Canadian Neonatal Follow-Up Program

J Perinatol. 2021 May 25. doi: 10.1038/s41372-021-01080-z. Online ahead of print.

Objective: To compare neurodevelopmental outcomes of large and appropriate for gestational age (LGA, AGA) infants <29 weeks' gestation at 18-24 months of corrected age. Study design: Retrospective cohort study using the Canadian Neonatal Network and Canadian Neonatal Follow-Up Network databases. Primary outcome was a composite of death or significant neurodevelopmental impairment (NDI), defined as severe cerebral palsy, Bayley III cognitive, language and motor scores of <70, need for hearing aids or cochlear implant and bilateral visual impairment. Univariate and multivariable logistic analyses were applied for outcomes. Results: The study cohort comprised 170 LGA and 1738 AGA infants. There was no difference in significant NDI or individual components of the Bayley III between LGA and AGA groups. LGA was associated with the increased risk of death by follow-up, 44/170 (25.9%) vs. 320/1738 (18.4%) (aOR: 1.60 95% CI: 1.00-2.54). Conclusions: Risk of NDI was similar between LGA and AGA infants.

PMID: 34035448

18. Association of Infection in Neonates and Long-Term Neurodevelopmental Outcome
Elizabeth Sewell, Jessica Roberts, Sagori Mukhopadhyay

Review Clin Perinatol. 2021 Jun;48(2):251-261. doi: 10.1016/j.clp.2021.03.001
Perinatal and neonatal infection and associated inflammatory response may adversely affect brain development and lead to neurodevelopmental impairment. Factors that predict the risk of infection and subsequent adverse outcomes have been identified but substantial gaps remain in identifying mechanisms and interventions that can alter outcomes. This article describes the current epidemiology of neonatal sepsis, the pathogenesis of brain injury with sepsis, and the reported long-term neurodevelopment outcomes among survivors.

PMID: 34030812

19. Reliability and Validity of the Turkish Version of the Selective Control of the Upper Extremity Scale in Children with Cerebral Palsy
Merve Tunçdemir, Jale Karakaya, Mintaze Kerem-Günel

Phys Occup Ther Pediatr. 2021 May 24;1-14. doi: 10.1080/01942638.2021.1928809. Online ahead of print.

Aims: To investigate the psychometric properties of the Selective Control of the Upper Extremity Scale (SCUES). Methods: Fifty-two children (27 females and 25 males; mean age 9.8 ± 4.4 years) with spastic type of cerebral palsy (CP) participated in the study. Psychometric analyses included reliability, concurrent validity, construct validity, and discriminant validity. Upper Limb Physician's Rating Scale (ULPRS), Modified Ashworth Scale (MAS), Quality of Upper Extremity Skills Test (QUEST) were used for concurrent validity. Manual Ability Classification System (MACS) was used for construct validity. Differences in SCUES scores were determined between participants categorized according to their limb distribution and MACS levels. Results: Intra-rater reliability (intraclass correlation coefficient [ICC] = 0.98) of the SCUES was excellent. SCUES and ULPRS

(r = 0.87, p < 0.001), SCUES and MAS (r=-0.93, p < 0.001), SCUES and QUEST (r=0.81, p < 0.001) were highly correlated. SCUES and MACS (r=-0.67, p < 0.001) was moderately correlated. SCUES scores differed significantly between children classifed as MACS levels I versus II and III and between children with hemiparetic and diparetic CP. Conclusion: The SCUES appears to be a valid and reliable tool to assess selective voluntary motor control of the upper extremities in children with spastic CP, which may be useful in selecting and planning interventions.

PMID: 34030602

20. Measurement properties of the Gross Motor Function Classification System, Gross Motor Function Classification System-Expanded & Revised, Manual Ability Classification System, and Communication Function Classification System in cerebral palsy: a systematic review with meta-analysis
Daniele Piscitelli, Francesco Ferrarello, Alessandro Ugolini, Sofia Verola, Leonardo Pellicciari

Review Dev Med Child Neurol. 2021 May 24. doi: 10.1111/dmcn.14910. Online ahead of print.

Aim: To systematically review and meta-analyse the measurement properties of the Gross Motor Function Classification System (GMFCS), Gross Motor Function Classification System-Expanded & Revised (GMFCS-E&R), Manual Ability Classification System (MACS), and Communication Function Classification System (CFCS) in children with cerebral palsy (CP). Method: Six databases were searched. Articles on the measurement properties of the GMFCS, GMFCS-E&R, MACS, and CFCS administered to children with CP were included. Quality was assessed by means of the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) Risk of Bias checklist. The level and grading of evidence were defined for each measurement property. Results: Forty-four articles were included in the systematic review and 37 articles were included in the meta-analysis. The level (grading) of evidence was strong (positive) for reliability and construct validity. Content validity displayed an unknown level of evidence for the GMFCS, limited evidence (positive) for the MACS, and moderate evidence (positive) for the CFCS. There was moderate (positive) evidence for measurement error in the GMFCS and MACS. The level of evidence for responsiveness was unknown. No studies investigated cross-cultural validity. Interpretation: These instruments can be used by health care professionals and caregivers to quantify the constructs needed to measure ability in children with CP. Current high-quality evidence supports the use of these tools to classify ability in children with CP. Adopting the COSMIN guidelines, content, and cross-cultural validity should be investigated further.

PMID: 34028793

21. Can Deep Learning Hit a Moving Target? A Scoping Review of Its Role to Study Neurological Disorders in Children
Saman Sargolzaei

Review Front Comput Neurosci. 2021 May 5;15:670489. doi: 10.3389/fncom.2021.670489. eCollection 2021

Neurological disorders dramatically impact patients of any age population, their families, and societies. Pediatrics are among vulnerable age populations who differently experience the devastating consequences of neurological conditions, such as attention-deficit hyperactivity disorders (ADHD), autism spectrum disorders (ASD), cerebral palsy, concussion, and epilepsy. System-level understanding of these neurological disorders, particularly from the brain networks' dynamic perspective, has led to the significant trend of recent scientific investigations. While a dramatic maturation in the network science application domain is evident, leading to a better understanding of neurological disorders, such rapid utilization for studying pediatric neurological disorders falls behind that of the adult population. Aside from the specific technological needs and constraints in studying neurological disorders in children, the concept of development introduces uncertainty and further complexity topping the existing neurologically driven processes caused by disorders. To unravel these complexities, indebted to the availability of high-dimensional data and computing capabilities, approaches based on machine learning have rapidly emerged a new trend to understand pathways better, accurately diagnose, and better manage the disorders. Deep learning has recently gained an ever-increasing role in the era of health and medical investigations. Thanks to its relatively more minor dependency on feature exploration and engineering, deep learning may overcome the challenges mentioned earlier in studying neurological disorders in children. The current scoping review aims to explore challenges concerning pediatric brain development studies under the constraints of neurological disorders and offer an insight into the potential role of deep learning methodology on such a task with varying and uncertain nature. Along with pinpointing recent advancements, possible research directions are highlighted where deep learning approaches can assist in computationally targeting neurological disorder-related processes and translating them into windows of opportunities for interventions in diagnosis, treatment, and management of neurological disorders in children.

PMID: 34025380

Prevention and Cure

22. Evaluating an enhanced quality improvement intervention in maternity units: PReCePT trial protocol
Hannah Edwards, Maria Theresa Redaniel, Brent Opmeer, Tim Peters, Ruta Margelyte, Carlos Sillero Rejon, William Hollingworth, Pippa Craggs, Elizabeth Hill, Sabi Redwood, Jenny Donovan, Karen Luyt

BMJ Open Qual. 2021 May;10(2):e001204. doi: 10.1136/bmjoq-2020-001204.

The UK's National Institute for Health and Care Excellence Preterm labour and birth guideline recommends use of magnesium sulfate (MgSO4) in deliveries below 30 weeks' gestation to prevent cerebral palsy and other neurological problems associated with preterm delivery. Despite national guidance, the uptake of MgSO4 administration in eligible women has been slow. National Health Service England has rolled out the PReCePT (PRevention of Cerebral Palsy in Pre-Term labour) quality improvement (QI) toolkit to increase uptake of MgSO4 in preterm deliveries. The toolkit is designed to increase maternity staff knowledge about MgSO4 and provides training and practical tools to help staff consider use in eligible women. The PReCePT trial compares the effectiveness of two different methods of implementing the QI toolkit (standard versus enhanced support). The standard support arm (control) receives the QI toolkit and regional-level support for a midwife/obstetric 'champion'. The enhanced support arm (intervention) receives this plus additional clinical backfill funding and unit-level QI microcoaching. It is funded by The Health Foundation. This is a cluster randomised controlled trial designed to include 48 maternity units randomised (2:1 ratio) to standard or enhanced support. Units are eligible for inclusion if they have 10 or more preterm (<30 weeks' gestation) deliveries annually and MgSO4 uptake of 70% or less. Randomisation is stratified by previous level of MgSO4 uptake. The QI intervention is implemented over 9 months. All units are followed up for a further 9 months. Blinding is not possible due to the nature of the intervention. The primary outcome is the proportion of MgSO4 uptake among eligible women at follow-up, adjusting for uptake before implementation of the toolkit. The effectiveness of the intervention will be assessed using weighted linear regression on data from the National Neonatal Research Database. Semistructured qualitative staff interviews will inform understanding of the process and outcomes. Economic evaluation will describe total costs and cost-effectiveness. Trial registration number SRCTN 40938673.

PMID: 34031151