

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. Assessment of bimanual performance in 3-D movement analysis: Validation of a new clinical protocol in children with unilateral cerebral palsy.

Gaillard F, Cacioppo M, Bouvier B, Bouzille G, Newman CJ, Pasquet T, Cretual A, Rauscent H, Bonan I.

Ann Phys Rehabil Med. 2019 Jul 10. pii: S1877-0657(19)30099-5. doi: 10.1016/j.rehab.2019.06.008. [Epub ahead of print]

BACKGROUND: The "Be an Airplane Pilot" (BE-API) protocol is a novel 3-D movement analysis (3DMA) protocol assessing the bimanual performance of children during a game. **OBJECTIVE:** This study aimed to investigate the reliability and validity of this protocol in children with unilateral cerebral palsy (uCP). **METHODS:** Angular waveforms (WAVE), maximum angles (MAX) and range of motion (ROM) of the trunk, shoulder, elbow and wrist joints were collected in children with uCP and in typically developing children (TDC) during 4 tasks of the BE-API protocol designed to explore specific degrees of freedom (DoF). The inter-trial reliability was assessed with the coefficient of multiple correlation (CMC) for WAVE and the intraclass correlation coefficient (ICC) and standard error of measurement (SEM) for MAX and ROM. Clinical performance-based measures, including the Assisting Hand Assessment (AHA) and ABILHAND-Kids scores, were used to explore correlations between clinical measures and kinematic parameters in children with uCP. **RESULTS:** For the 20 children with uCP (13 boys; mean age 12.0 [SD 3.2] years) and 20 TDC (11 boys; mean age 11.9 [SD 3.4] years), most kinematic parameters showed high reliability (WAVE: CMC \geq 0.82; MAX and ROM: ICC \geq 0.85, SEM \leq 4.7°). Elbow extension, forearm supination, and wrist adduction were reduced and wrist flexion was increased for children with uCP versus TDC (P \leq 0.01). In children with uCP, MAX and ROM values were moderately correlated with clinical assessments (AHA score: r=0.48-0.65; ABILHAND-Kids score: r=0.48-0.49). **CONCLUSIONS:** The BE-API protocol is a 3DMA-bimanual performance-based assessment that is highly reliable in children with uCP. Children with uCP and TDC significantly differed in some clinically relevant kinematic parameters. The BE-API is a promising playful tool, helpful for better understanding upper-limb motor movement abnormalities in bimanual conditions and for tailoring treatments to individual deficits.

PMID: [31301386](#)

2. Inter-intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy.

Ozal C, Ari G, Gunel MK.

Acta Orthop Traumatol Turc. 2019 Jul 11. pii: S1017-995X(18)30052-X. doi: 10.1016/j.aott.2019.04.013. [Epub ahead of print]

OBJECTIVE: The aim of this study was to demonstrate the inter and intra rater reliability and validity of the Turkish version of the Trunk Control Measurement Scale (TCMS) for children with CP. **METHODS:** Fifty children (21 girls and 29 boys; mean age 6.6 \pm 2.3 years) with spastic, dyskinetic and ataxic types of CP were participated in the study. Children with Level I-

II and III according to Gross Motor Function Classification System (GMFCS) were included into the study. All children were evaluated separately by two physiotherapists for interrater reliability and they re-evaluated for intra rater reliability. Gross Motor Function Measurement total score and B part were used for construct validity. RESULTS: The intraclass correlation coefficient (ICC) value of the inter-rater reliability for the Turkish TCMS was 95% CI (0.823-886), and the intra-rater reliability was 95% CI (0.986-0.992). The Spearman rank correlation coefficient between the Turkish TCMS and the Gross Motor Function Measure total score r: 0.827; $p < 0.05$ Part B was r: 0.863; $p < 0.05$. CONCLUSION: The results of the study support that the Turkish TCMS has a high inter and intra rater reliability and validity similar to the original version. Thus, the Turkish TCMS appears to be a suitable evaluation tool to assess the qualitative performance of trunk control and sitting balance for children with CP and it gives opportunity to use clinically and research purposes. LEVEL OF EVIDENCE: Level III, Diagnostic Study.

PMID: [31303422](#)

3. Physical therapy treatment in children with cerebral palsy after single-event multilevel surgery: a qualitative systematic review. A first step towards a clinical guideline for physical therapy after single-event multilevel surgery.

van Bommel EEH, Arts MME, Jongerius PH, Ratter J, Rameckers EAA.

Ther Adv Chronic Dis. 2019 Jul 5;10:2040622319854241. doi: 10.1177/2040622319854241. eCollection 2019.

BACKGROUND: The aim of this study was to review available evidence for physical therapy treatment (PTT) after single-event multilevel surgery (SEMLS), and to realize a first step towards an accurate and clinical guideline for developing effective PTT for children with cerebral palsy (CP) after SEMLS. METHODS: A qualitative systematic review (PubMed, Medline, Embase, CINAHL, and the Cochrane Library) investigating a program of PTT after SEMLS in children aged 4-18 years with CP classified by Gross Motor Function Classification System level I-III. RESULTS: Six articles meeting the inclusion criteria were selected. The selected studies provide only incomplete descriptions of interventions, and show no consensus regarding PTT after SEMLS. Neither do they show any consensus on the outcome measures or measuring instruments. CONCLUSIONS: Based on the results of this literature review in combination with our best practice, we propose a preliminary protocol of PTT after SEMLS.

PMID: [31308923](#)

4. Improving Health-related Quality of Life for Patients With Nonambulatory Cerebral Palsy: Who Stands to Gain From Scoliosis Surgery?

Miller DJ, Flynn JJM, Pasha S, Yaszay B, Parent S, Asghar J, Abel MF, Pahys JM, Samdani A, Hwang SW, Narayanan UG, Sponseller PD, Cahill PJ; Harms Study Group.

J Pediatr Orthop. 2019 Jul 12. doi: 10.1097/BPO.0000000000001424. [Epub ahead of print]

INTRODUCTION: It is unclear what factors influence health-related quality of life (HRQOL) in neuromuscular scoliosis. The aim of this study was to evaluate which factors are associated with an improvement in an HRQOL after spinal fusion surgery for nonambulatory patients with cerebral palsy (CP). METHODS: A total of 157 patients with nonambulatory CP (Gross Motor Function Classification System IV and V) with a minimum of 2-year follow-up after PSF were identified from a prospective multicenter registry. Radiographs and quality of life were evaluated preoperatively and 2 years postoperatively. Quality of life was evaluated using the validated Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) questionnaire. Patients who had an increase of 10 points or greater from baseline CPCHILD scores were considered to have meaningful improvement at 2 years postoperatively. 10 points was chosen as a threshold for meaningful improvement based on differences between Gross Motor Function Classification System IV and V patients reported during the development of the CPCHILD. Perioperative demographic, clinical, and radiographic variables were analyzed to determine predictors for meaningful improvement by univariate and multivariate regression analysis. RESULTS: A total of 36.3% (57/157) of the patients reported meaningful improvement in CPCHILD scores at 2 years postoperatively. Preoperative radiographic parameters, postoperative radiographic parameters, and deformity correction did not differ significantly between groups. Patients who experienced meaningful improvement from surgery had significantly lower preoperative total CPCHILD scores (43.8 vs. 55.2, $P < 0.001$). On backwards conditional binary logistic regression, only the preoperative comfort, emotions, and behavior domain of the CPCHILD was predictive of meaningful improvement after surgery ($P \leq 0.001$). CONCLUSION: Analysis of 157 CP patients revealed a meaningful improvement in an HRQOL in 36.3% of the patients. These patients tended to have lower preoperative HRQOL, suggesting more "room for improvement" from surgery. A lower score within the comfort, emotions, and behavior domain of the CPCHILD was predictive of meaningful improvement after surgery. Radiographic parameters of deformity or curve correction were not associated with meaningful improvement after surgery. LEVEL OF EVIDENCE: Level II-retrospective review of prospectively collected data.

PMID: [31306277](#)

5. Functional outcomes after selective dorsal rhizotomy followed by minimally invasive tendon lengthening procedures in children with spastic cerebral palsy.

Limpaphayom N, Stewart S, Wang L, Liu J, Park TS, Dobbs MB.

J Pediatr Orthop B. 2019 Jul 11. doi: 10.1097/BPB.0000000000000642. [Epub ahead of print]

Many surgical options have been proposed to improve the ambulatory status of children with spastic cerebral palsy (CP), but none have focused on addressing both spasticity and lower extremity tendon contractures. The purpose of this study is to evaluate the results of selective dorsal rhizotomy (SDR) followed by minimally invasive tendon lengthening allowing immediate return to ambulation. Two hundred fifty-five spastic CP patients (who received SDR procedure at an average age of 6.9 ± 2.6 years and tendon lengthening procedure at an average age of 7.2 ± 2.5 years) were retrospectively reviewed. Patients were grouped by the gross motor function classification system (GMFCS) 1-3 and 4-5. Kaplan-Meier analysis and Cox proportional hazard model using a requirement for additional tendon lengthening as an end point were conducted. Tendon lengthening followed SDR at an average of 4.3 ± 10.7 months. On an average of 4.9 ± 1.2 years after tendon lengthening, GMFCS was improved in 28 and maintained in 213 patients, respectively. There was no difference of variables and joint angles between the two GMFCS groups. A repeat tendon lengthening was required in 19 patients. The Kaplan-Meier analysis showed 81% success rate. Cox proportional hazard model identified age at tendon lengthening [hazards ratio (HR), 0.53; 95% confidence interval (CI), 0.37-0.76] and duration between SDR and tendon lengthening of more than 6 months (HR, 2.96; 95% CI, 1.05-8.33) associated with need for a repeat tendon lengthening procedure. Our novel approach of SDR/tendon lengthening results in improved joint angles as well as stable or improved GMFCS. Longer follow-up is necessary to determine if this approach could prolong ambulatory ability and reduced need for more invasive orthopedic surgeries.

PMID: [31305364](#)

6. Experience-based decision-tree process for selective dorsal rhizotomy based on clinical assessment in children with cerebral palsy.

Parent A, Marois P, Letellier G, Raison M, Mercier C, Ballaz L.

Ann Phys Rehabil Med. 2019 Jul 12. pii: S1877-0657(19)30101-0. doi: 10.1016/j.rehab.2019.06.010. [Epub ahead of print]

PMID: [31302282](#)

7. Percutaneous Hamstring Lengthening Surgery is as Effective as Open Lengthening in Children With Cerebral Palsy.

Nazareth A, Rethlefsen S, Sousa TC, Mueske NM, Wren TAL, Kay RM.

J Pediatr Orthop. 2019 Aug;39(7):366-371. doi: 10.1097/BPO.0000000000000924.

BACKGROUND: Surgical lengthening of the hamstrings is often performed to correct crouch gait in children with cerebral palsy (CP). Previous studies have demonstrated the effectiveness of open hamstring lengthening (oHSL) in improving knee extension static and dynamic range of motion; however, literature regarding percutaneous hamstring lengthening (pHSL) is limited. The purpose of this study was to investigate the effect of open versus pHSL for improving crouch gait and knee function in children with CP. **METHODS:** This retrospective cohort study included 87 ambulatory children with CP who underwent HLS surgery with both preoperative and postoperative gait analysis (mean time, 29.4 ± 19.9 mo after surgery) testing between 1997 and 2015. In total, 65 patients underwent oHLS surgery (mean age, 8.5 ± 2.5 y) and 22 patients underwent pHSL surgery (mean age, 8.3 ± 2.3 y). Lower extremity three-dimensional kinematic data were collected while subjects walked at a self-selected speed. Outcome variables for operative limbs were compared within and between groups using t tests, χ tests, and multiple regression analysis. **RESULTS:** Significant postoperative decreases in knee flexion at initial contact were seen for both open ($\Delta 12.7 \pm 13.4$ degrees; $P < 0.001$) and percutaneous ($\Delta 19.1 \pm 13.1$ degrees; $P < 0.001$) groups. Increased postoperative maximum knee extension in stance was found for both open ($\Delta 8.2 \pm 16.8$ degrees; $P = 0.001$) and percutaneous ($\Delta 14.4 \pm 16.5$ degrees; $P = 0.001$) groups. No significant differences between open and percutaneous groups were found when comparing postoperative changes in kinematic variables between groups after adjusting for covariates. Postoperative changes in static range of motion were similar between lengthening groups. **CONCLUSIONS:** pHSL is as effective as open lengthening in improving stance phase knee kinematics during gait in children with CP. This is the first study to compare the kinematic effects of open versus pHSL in the pediatric population. Percutaneous lengthening is tolerated well by patients, and as it allows for rapid rehabilitation it may be preferable to the open procedure. **LEVEL OF EVIDENCE:** Level III-retrospective comparative study.

PMID: [31305380](#)

8. Differences of the ankle plantar flexor length in typically developing children and children with spastic hemiplegic cerebral palsy.

Lee DY.

J Exerc Rehabil. 2019 Jun 30;15(3):445-448. doi: 10.12965/jer.1938216.108. eCollection 2019 Jun.

The purpose of this study is to analyze the lengths of the medial and lateral gastrocnemius and soleus muscles in children with spastic hemiplegic cerebral palsy to quantitatively assess the structural differences in skeletal muscles. This study included 10 children with spastic cerebral palsy and 10 children with typically development. To assess the changes in the length of the ankle plantar flexor due to cerebral palsy, we utilized both gait analysis and software for interactive musculoskeletal modeling to model skeletal muscle length. With this model, the differences in the lengths of the medial and lateral gastrocnemius and soleus muscles were assessed at different knee (0°, 45°, and 90°) and ankle (-10°, 0°, 15°, and 30°) angles. Muscle length on the paretic group was shorter than the typically developing and nonparetic group for all three muscles (medial and lateral gastrocnemius and soleus muscles) for knee and ankle angles. These results were not statistically significant. Normalized muscle lengths in the dynamic/static status revealed a significant difference in the length of the lateral gastrocnemius muscle between the cerebral palsy and typically developing group. I observed muscle shortening on the paretic side of the children with cerebral palsy. This finding suggests that the recovery of plantar flexor length is the most important issue that must be resolved for normal gait and motor function.

PMID: [31316939](#)

9. Editorial: Motor Control of Gait and the Underlying Neural Network in Pediatric Neurology.

Meyns P, van den Bogaart M2, Theunissen K, van der Krogt MM, Ortibus E, Desloovere K.

Front Hum Neurosci. 2019 Jul 2;13:226. doi: 10.3389/fnhum.2019.00226. eCollection 2019.

PMID: [31312130](#)

10. Thinking outside the cardboard box: insights from a course to train rural Kenyans to make postural support devices from appropriate paper-based technology (APT) for children with cerebral palsy.

Lindoewood R, Bracegirdle C, Samia P, Westmacott J, Lindoewood P.

Disabil Rehabil Assist Technol. 2019 Jul 19:1-7. doi: 10.1080/17483107.2019.1629653. [Epub ahead of print]

Purpose: Suitable assistive devices for children with cerebral palsy (CP) in low-income countries are often unavailable. Devices made from APT are in use in several countries but are unevaluated. Materials and methods: A 2-week training course focused on APT principles, measuring children and constructing postural support devices. Twenty-three Kenyans attended the course. The host organization identified four local children with CP who attended for assessment and measurement. Participants made the devices and children returned for fitting and necessary adjustment. Completion of post-course forms, action plans, visits after 14 months and contact 3 years later comprised the evaluation. Results: All participants found the course beneficial and valued the networking opportunity provided. They appreciated the practicality and utility of locally manufactured cost effective devices. The trainees planned further implementation to provide assistive devices for children with CP in their localities. Follow-up visits revealed several challenges to local ongoing production. Conclusions: Training people in low-income communities to make bespoke assistive devices for children with CP is straightforward, and the course was positively evaluated. However, maintaining device production is limited without local group support and stable leadership, ideally as part of an existing programme. Implications for rehabilitation Assistive devices are often unobtainable for children with cerebral palsy (CP) in low-income countries. APT is a cost effective way of fulfilling this need and it is relatively straightforward to train people who care for or work with those with CP to make devices using APT. Feedback from APT training suggests participants find the technique a practical way of producing assistive equipment for individuals with CP in their community. Maintaining device production requires support, leadership and increased public awareness of the use of APT at a local level.

PMID: [31322462](#)

11. Effectiveness of interactive computer play on balance and postural control for children with cerebral palsy: A systematic review.

Pin TW.

Gait Posture. 2019 Jul 6;73:126-139. doi: 10.1016/j.gaitpost.2019.07.122. [Epub ahead of print]

BACKGROUND: Interactive computer play (ICP) becomes popular in rehabilitation for children with cerebral palsy (CP). With the nature of ICP, it could be an effective intervention specifically to improve balance and postural control for children with CP. The present paper aimed to review the effectiveness of ICP on postural control and balance for children with CP. **METHODS:** Electronic databases including Medline, AMED, EBSCOhost, PsycINFO, Embase, the Cochrane Library and the DARE were searched up to September 2018. Studies were included if (1) participants were aged under 18 and had CP, (2) ICP intervention was performed, (3) an explicit objective was postural control and balance of the participants, and (4) results were fully published in English-language peer-reviewed journals. Characteristics of study participants, ICP protocols and study results were extracted. Level of evidence of each studies was graded using the guidelines from the American Academy of Cerebral Palsy and Developmental Medicine. Methodological quality was graded using the Physiotherapy Evidence Database (PEDro) scale. Effect sizes were calculated on available data. **RESULTS:** Twenty studies were included, with nine of level I or II evidence. Most studies had fair methodological rigor. Huge variations in the study designs and protocols of ICP were found among the studies. **CONCLUSIONS:** ICP seemed to be more effective than conventional therapy in improving postural control and balance, with medium to large effect sizes for children with mild to moderate severity of CP. Future studies of high methodological rigour are required to verify the role of on-site guidance of the children during ICP and the effect on children with more severe CP.

PMID: [31323621](#)

12. The Role of Regular Physical Therapy on Spasticity in Children With Cerebral Palsy.

Lee H, Kim EK, Son DB, Hwang Y, Kim JS, Lim SH, Sul B, Hong BY.

Ann Rehabil Med. 2019 Jun;43(3):289-296. doi: 10.5535/arm.2019.43.3.289. Epub 2019 Jun 28.

OBJECTIVE: To investigate the effect of physical therapy (PT) intervention on spasticity in patients with cerebral palsy (CP), and to assess the degree of deterioration of spasticity when regular PT is interrupted in those patients. **METHODS:** We recruited 35 children with spastic CP who visited our hospital for PT, and whose Modified Tardieu Scale (MTS) scores were serially recorded including before and after a 10-day public holiday time frame period. The outcome measures were the angle of range of motion (ROM) of dorsiflexion of the ankle joint (R1 and R2) in the knee flexion and extension positions as assessed using the MTS. **RESULTS:** The range of dorsiflexion of the ankle joint (R1 and R2) after the holiday period was significantly decreased as compared with that measured ROM noted before the holiday period, regardless of the knee position, age, or gross motor function. The dynamic component of the MTS (R2-R1) showed a slight decrease in the knee flexion position. **CONCLUSION:** Interruption of regular PT aggravated spasticity and decreased ankle joint ROM in children with spastic CP. Our findings suggest that regular PT in the care continuum for children with CP is crucial for the maintenance of ROM in the spastic ankle joints.

PMID: [31311250](#)

13. Comparing parent and provider priorities in discussions of early detection and intervention for infants with and at risk of cerebral palsy.

Byrne R, Duncan A, Pickar T, Burkhardt S, Boyd RN, Neel ML, Maitre NL.

Child Care Health Dev. 2019 Jul 19. doi: 10.1111/cch.12707. [Epub ahead of print]

BACKGROUND: Although literature suggests that parents need support when their child is diagnosed with cerebral palsy (CP), it is unclear to what extent providers implement these supports in practice and what parental perspectives surround provider early diagnosis and management of CP. Therefore, we aimed to characterize and compare experiences of providers and parents of children with CP with regards to early detection and intervention. **METHOD:** Seventeen parents participated in day-long world-café style workshops focused on categories extracted from the International Classification of Function (ICF) framework and recent systematic reviews of early detection for CP. Thirty regional providers (generalists, specialists, therapists) caring for infants with CP completed surveys with scaled-score and open-ended questions. Quantitative and qualitative data were independently assessed by two reviewers to identify prominent themes. **RESULTS:** All parents (100%)

stated early diagnosis or high-risk for CP classification was beneficial compared to only 50% of providers who often gave early CP diagnoses before 12 months. Top parent priorities were honesty and positively-phrased messages. Providers most often addressed cognition, primary care need, motor and feeding issues (80%, 62%, 54%, 54% frequently/sometimes). Matching priorities for discussion were neuroimaging timing/risk/benefit, cognition, primary care, motor and feeding/nutrition. Discordance occurred for participation, parent wellbeing, pain and vision, with parents wanting more education and resources. CONCLUSIONS: Receiving early diagnoses or high-risk for CP classification is a parent priority. Alignment between parents and providers exists for ICF domains of body functions/structures and activity, but less for those of environment, personal and participation.

PMID: [31323144](#)

14. Establishing community pathways for the early recognition of cerebral palsy: red flags, enablement, and family support.

Msall ME.

Dev Med Child Neurol. 2019 Jul 16. doi: 10.1111/dmcn.14314. [Epub ahead of print]

PMID: [31313287](#)

15. [Speech disorders in children with cerebral palsy: diagnostics and correction].

Nemkova SA.

Zh Nevrol Psikhiatr Im S S Korsakova. 2019;119(5):112-119. doi: 10.17116/jnevro2019119051112. [Article in Russian; Abstract available in Russian from the publisher]

This lecture presents general information about children cerebral palsy concerning current views on its causes and pathogenesis as well as the data on different classifications of speech disorders (localization of lesions, clinical presentations) and their prevalence, which are important for general practitioners. Special attention is drawn to the principles and tasks of diagnostics of speech disorders, organization of treatment-correction measures considering all possible approaches to the care of patients.

PMID: [31317899](#)

16. Differentiating Typical From Atypical Speech Production in 5-Year-Old Children With Cerebral Palsy: A Comparative Analysis.

Hustad KC, Sakash A, Broman AT, Rathouz PJ.

Am J Speech Lang Pathol. 2019 Jul 15;28(2S):807-817. doi: 10.1044/2018_AJSLP-MS18-18-0108. Epub 2019 Jul 15.

Objective Early diagnosis of speech disorders in children with cerebral palsy (CP) is of critical importance. A key problem is differentiating those with borderline or mild speech motor deficits from those who are within an age-appropriate range of variability. We sought to quantify how well functional speech measures differentiated typically developing (TD) children from children with CP. Method We studied speech production in 45 children with CP (26 with clinical speech motor impairment [SMI] and 19 with no evidence of speech motor impairment [NSMI]) and in 29 TD children of the same age. Speech elicitation tasks were used. Intelligibility, speech rate, and intelligible words per minute were examined. Results All measures differentiated between all 3 groups of children with considerable precision based on area under the receiver operating characteristic curve (AUC) data. AUC was highest for overall intelligibility, which ranged from .88 to .99. Intelligible words per minute also yielded very strong AUCs, ranging from .81 to .99. In each of the receiver operating characteristic models, discrimination between groups was highest for children with speech motor impairment versus TD children. Data indicated that 90% of TD children had overall intelligibility above 87% at 5 years of age, but that no child was 100% intelligible. Furthermore, 90% children with SMI had intelligibility below 72%. Conclusion Findings suggest that functional speech measures differentiate very clearly between children with and without CP and that even children who do not show evidence of speech motor impairment have functional differences in their speech production ability relative to TD peers.

PMID: [31306596](#)

17. Nutrient-enriched formula versus standard formula for preterm infants.

Walsh V, Brown JVE, Askie LM, Embleton ND, McGuire W.

Cochrane Database Syst Rev. 2019 Jul 17;7:CD004204. doi: 10.1002/14651858.CD004204.pub3. [Epub ahead of print]

BACKGROUND: Preterm infants may accumulate nutrient deficits leading to extrauterine growth restriction. Feeding preterm infants with nutrient-enriched rather than standard formula might increase nutrient accretion and growth rates and might improve neurodevelopmental outcomes. **OBJECTIVES:** To compare the effects of feeding with nutrient-enriched formula versus standard formula on growth and development of preterm infants **SEARCH METHODS:** We used the Cochrane Neonatal standard search strategy. This included electronic searches of the Cochrane Central Register of Controlled Trials (CENTRAL; 2018, Issue 11), MEDLINE, Embase, and the Cumulative Index to Nursing and Allied Health Literature (until November 2018), as well as conference proceedings, previous reviews, and clinical trials databases. **SELECTION CRITERIA:** Randomised and quasi-randomised controlled trials that compared feeding preterm infants with nutrient-enriched formula (protein and energy plus minerals, vitamins, or other nutrients) versus standard formula. **DATA COLLECTION AND ANALYSIS:** We extracted data using the Cochrane Neonatal standard methods. Two review authors separately evaluated trial quality and extracted and synthesised data using risk ratios (RRs), risk differences, and mean differences (MDs). We assessed certainty of evidence at the outcome level using Grading of Recommendations Assessment, Development and Evaluation (GRADE) methods. **MAIN RESULTS:** We identified seven trials in which a total of 590 preterm infants participated. Most participants were clinically stable preterm infants of birth weight less than 1850 g. Few participants were extremely preterm, extremely low birth weight, or growth restricted at birth. Trials were conducted more than 30 years ago, were formula industry funded, and were small with methodological weaknesses (including lack of masking) that might bias effect estimates. Meta-analyses of in-hospital growth parameters were limited by statistical heterogeneity. There is no evidence of an effect on time to regain birth weight (MD -1.48 days, 95% confidence interval (CI) -4.73 to 1.77) and low-certainty evidence suggests that feeding with nutrient-enriched formula increases in-hospital rates of weight gain (MD 2.43 g/kg/d, 95% CI 1.60 to 3.26) and head circumference growth (MD 1.04 mm/week, 95% CI 0.18 to 1.89). Meta-analysis did not show an effect on the average rate of length gain (MD 0.22 mm/week, 95% CI -0.70 to 1.13). Fewer data are available for growth and developmental outcomes assessed beyond infancy, and these do not show consistent effects of nutrient-enriched formula feeding. Data from two trials did not show an effect on Bayley Mental Development Index scores at 18 months post term (MD 2.87, 95% CI -1.38 to 7.12; moderate-certainty evidence). Infants who received nutrient-enriched formula had higher Bayley Psychomotor Development Index scores at 18 months post term (MD 6.56, 95% CI 2.87 to 10.26; low-certainty evidence), but no evidence suggested an effect on cerebral palsy (typical RR 0.79, 95% CI 0.30 to 2.07; 2 studies, 377 infants). Available data did not indicate any other benefits or harms and provided low-certainty evidence about the effect of nutrient-enriched formula feeding on the risk of necrotising enterocolitis in preterm infants (typical RR 0.72, 95% CI 0.41 to 1.25; 3 studies, 489 infants). **AUTHORS' CONCLUSIONS:** Available trial data show that feeding preterm infants nutrient-enriched (compared with standard) formulas has only modest effects on growth rates during their initial hospital admission. No evidence suggests effects on long-term growth or development. The GRADE assessment indicates that the certainty of this evidence is low, and that these findings should be interpreted and applied with caution. Further randomised trials would be needed to resolve this uncertainty.

PMID: [31314903](#)**18. Oral health outcomes for people with cerebral palsy: a scoping review protocol.**

Lansdown K, Smithers-Sheedy H, Coulton KM, Irving M.

JBI Database System Rev Implement Rep. 2019 Jul 15. doi: 10.11124/JBISRIR-2017-004037. [Epub ahead of print]

OBJECTIVE: This review aims to systematically map the literature reporting on oral health outcomes the health indicate is a measure experienced by people with cerebral palsy. **INTRODUCTION:** At present, there are no documented systematic reviews reporting on oral health outcomes for people of all ages with cerebral palsy. Subsequently, there are no clear guidelines, frameworks or detailed oral health recommendations for people with cerebral palsy. Considering the importance of oral health on general well-being and quality of life, it is important that it is not overlooked when focusing on patient-centered care for people with cerebral palsy. **INCLUSION CRITERIA:** Studies that focus on oral health, including dental diagnosis, trauma and/or treatment, facial pain, saliva, and sleep apnea, and/or make statements regarding oral health pertaining to cerebral palsy will be considered for inclusion in this scoping review. **METHODS:** This review will be conducted in accordance with the guidelines outlined by JBI methodology for scoping reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR). Articles published in any language will be considered for inclusion, with no restriction on publication date. The search databases will include the Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, Scopus, Embase and Dentistry and Oral Science. A search of gray literature will also be conducted. Extracted data relevant to the scoping review will be performed by two reviewers.

PMID: [31313707](#)

19. Self-Care Trajectories and Reference Percentiles for Children with Cerebral Palsy.

Palisano RJ, Chiarello LA, Avery L, Hanna S; On Track Study Team.

Phys Occup Ther Pediatr. 2019 Jul 18:1-17. doi: 10.1080/01942638.2019.1642288. [Epub ahead of print]

Aims: To create longitudinal trajectories and reference percentiles for performance in self-care of children with cerebral palsy (CP). **Methods:** Participants were 708 children with CP, 18 months through 11 years of age and their parents residing in 10 regions across Canada and the United States. Gross Motor Function Classification System (GMFCS) levels were determined by consensus between parents and therapists. Parents' completed the Performance in Self-Care domain of the Child Engagement in Daily Life Measure two to five times at 6-month intervals. Nonlinear mixed-effects models were used to create longitudinal trajectories. Quantile regression was used to construct cross-sectional reference percentiles. **Results:** The trajectories for children in levels I, II, and III are characterized by an average maximum score between 79.6 (level I) and 62.8 (level III) and an average attainment of 90% of the maximum score between 7 and 9 years of age. The trajectories for children in level IV and V show minimal change over time. Extreme variation in performance among children of the same age and GMFCS level complicate interpretation of percentile change of individual children. **Conclusion:** The findings are useful for monitoring self-care of children with CP and evaluating change for children in GMFCS levels I-III.

PMID: [31318307](#)**20. Assessment of pain, care burden, depression level, sleep quality, fatigue and quality of life in the mothers of children with cerebral palsy.**

Albayrak I, Biber A, Çalışkan A, Levendoglu F.

J Child Health Care. 2019 Jul 18:1367493519864751. doi: 10.1177/1367493519864751. [Epub ahead of print]

The aim of this study were to evaluate pain, care burden, depression level, sleep quality, fatigue and quality of life (QoL) among a group of mothers of children with cerebral palsy (CP) and to compare their results with a group of healthy controls. The study involved 101 mothers who had children with CP and 67 mothers who had a healthy child as the control group. Pain, care burden, depression level, sleep quality, fatigue and QoL of all the participants were evaluated by the numerical rating scale, the Zarit care burden scale (ZCBS), the beck depression inventory (BDI), the Pittsburgh sleep quality index (PSQI), the checklist individual strength (CIS) and the short form-36 (SF-36), respectively. Numerical rating scale value was 3.57 ± 2.96 in the patient group. When the two groups were compared, the CP group showed higher scores for ZCBS, BDI, PSQI, total CIS and SF-36 subscales of general health and vitality whereas the scores for role physical, role emotional, mental health and mental component summary were found to be lower in the patients, compared to the control group. Reducing caregiving burden of the mothers' by other family members and increasing psychosocial supports may help improve the mother's health status.

PMID: [31319696](#)**21. Health-related quality of life in children with neurodevelopmental disabilities: assessment of a scoping review.**

Butler C.

Dev Med Child Neurol. 2019 Jul 18. doi: 10.1111/dmcn.14317. [Epub ahead of print]

PMID: [31318042](#)**22. Birth weight discordance in very low birth weight twins: mortality, morbidity, and neurodevelopment.**

Boghossian NS, Saha S, Bell EF, Brumbaugh JE, Shankaran S, Carlo WA, Das A; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network.

J Perinatol. 2019 Jul 16. doi: 10.1038/s41372-019-0427-5. [Epub ahead of print]

OBJECTIVE: Examine outcomes among birth weight concordant and discordant 401-1500 g twins. **STUDY DESIGN:** Twins (n = 8,114) at NICHD Neonatal Research Network (1994-2011) were studied. Discordance (birth weight difference/larger twin birth weight x 100%) was categorized into: ≤ 14 , $> 14-20$, $> 20-30$, and $> 30\%$. Separate logistic regression models for the

smaller and larger infants assessed the adjusted association between discordance and outcomes. **RESULTS:** Compared with the smaller twin with $\leq 14\%$ discordance, mortality, necrotizing enterocolitis, severe retinopathy of prematurity, bronchopulmonary dysplasia, and neurodevelopmental impairment or death were highest among the smaller twins with discordance $> 30\%$. The larger twins with discordance $> 30\%$ had higher odds of patent ductus arteriosus, moderate-to-severe cerebral palsy, blindness, cognitive and motor scores < 70 . Odds of cerebral palsy and blindness were also higher among the larger twins with discordance $> 14\text{--}20\%$. **CONCLUSIONS:** Discordance $> 30\%$ was associated with higher mortality in the smaller twin and higher morbidities among the smaller and larger twins.

PMID: [31312035](#)

23. Life Course Health Development Outcomes After Prematurity: Developing a Community, Clinical, and Translational Research Agenda to Optimize Health, Behavior, and Functioning.

Msall ME, Sobotka SA, Dmowska A, Hogan D, Sullivan M.

EditorsIn: Halfon N1, Forrest CB2, Lerner RM3, Faustman EM4, editors. SourceHandbook of Life Course Health Development [Internet]. Cham (CH): Springer; 2018. 2017 Nov 21.

Long-term survival for infants born extremely prematurely (<28 weeks of gestation) and extremely low birth weight (<1000 g) has increased dramatically due to obstetrical and neonatal advances. However, poverty, inequality, and resulting health disparities are significant contributors to women who give birth to preterm infants and also impact their children's healthy development and education. While the vast majority of survivors of extreme prematurity do not have the most severe forms of neurodevelopmental disability (i.e., cerebral palsy, blindness, sensorineural hearing loss >55 dB, and intellectual disability), half of survivors can be expected to require special education services at kindergarten entry and during their school years. In addition, there are also high rates of health disparities in the prevalence of preterm birth across the spectrum of gestations including very preterm (28–31 weeks), moderate preterm (32–33 weeks), and late preterm births (34–36 weeks). Life course health development offers a valuable framework for examining how complex medical and social adversities that impact a mother's health can also impact their child's health and developmental trajectories. A better understanding of the cumulative impact of protective factors and other buffers that can support prenatal and postnatal parental and child health will provide important insights into how to promote greater resiliency and optimal health development. This population-based information can provide ongoing data for thriving developmental health trajectories for vulnerable preterm survivors with respect to physical, behavioral, and social health outcomes. Though premature infants who receive comprehensive early intervention and preschool educational supportive services have improved outcomes at kindergarten entry, school-age survivors, even those escaping major neurodevelopmental diagnoses, have challenges which impact attention, behavioral regulation, academic achievement, and social skills compared to their full-term peers. Unfortunately, many essential services that can contribute to better outcomes are unnecessarily fragmented and not systematically implemented to provide preventive interventions that optimize health, learning, executive function, social, and adaptive competencies. These cumulative medical, developmental, and social risks among preterm survivors adversely impact long-term adult physical and behavioral health, educational attainment, and social participation. In order to address these disparities, more precise, population-based, health development interventions aimed at optimizing physical and behavioral health, educational achievement, and adaptive competencies will be required. We recommend research strategies to inform our efforts for improving life course outcomes.

PMID: [31314296](#)

24. Emerging Issues in Cerebral Palsy Associated With Aging: A Psychiatrist Perspective.

Yi YG, Jung SH, Bang MS.

Ann Rehabil Med. 2019 Jun;43(3):241-249. doi: 10.5535/arm.2019.43.3.241. Epub 2019 Jun 28.

The population of adults diagnosed with cerebral palsy (CP) is increasing along with the survival rate of children born with the disability. Adults with CP need health services for the continued monitoring and management of their condition. Moreover, the development of additional health problems in adulthood increases the need for ongoing access to health services. Adults with CP manifest a higher rate of chronic health conditions and eventual decline in strength and functional reserve, deterioration in physical activity, increased risk of musculoskeletal complications, and gradual changes in swallowing ability. They are also reported to exhibit difficulty engaging socially and have a low health-related quality of life (QOL). However, there are a large number of adults with CP who cannot access medical services adequately and are therefore not effectively treated. To overcome these apparent challenges, we need to fully comprehend the healthcare needs of adults with CP to develop adult-focused health services. Further research is needed regarding the impact of physical activity, nutrition, sarcopenia, myeloradiculopathy, and swallowing function on QOL.

PMID: [31311245](#)

25. Heterogeneity in age at death for adults with developmental disability.

Landes SD, Stevens JD, Turk MA.

J Intellect Disabil Res. 2019 Jul 16. doi: 10.1111/jir.12672. [Epub ahead of print]

BACKGROUND: Although increased attention has been devoted to mortality trends for adults with developmental disability, research has not accounted for possible differences in age at death between disability types. We examine whether heterogeneity is present in age at death between adults with different types of developmental disability. **METHODS:** Data were from the 2012-2016 U.S. Multiple Cause-of-Death Mortality files. Mean age at death and age at death distributions were analysed for adults, aged 18-126, with and without developmental disability collectively and then stratified by biological sex. **RESULTS:** There were 33 154 decedents with and 13 026 759 without developmental disability. Compared with adults without developmental disability, age at death was lower for all decedents with developmental disability but varied markedly by disability type and biological sex. Among adults with developmental disability, those with intellectual disability had the highest age at death, and those with cerebral palsy or other rare developmental disabilities, especially if co-morbid for a second developmental disability, had the lowest age at death. **CONCLUSION:** Research on age at death for adults with developmental disability must account for heterogeneity among disability types in order to ensure reliable estimates. Failure to do so conceals important differences between disability types, which can misguide public health and preventive care efforts to reduce premature mortality and/or provide aging-related supports.

PMID: [31313415](#)**26. Predictors of Adverse Events Following Cleft Palate Repair.**

Mets EJ, Chouairi F, Torabi SJ, Alperovich M.

J Craniofac Surg. 2019 Jul;30(5):1414-1418. doi: 10.1097/SCS.0000000000005542.

INTRODUCTION: Cleft palate repair has rare, but potentially life-threatening risks. Understanding the risk factors for adverse events following cleft palate repair can guide surgeons in risk stratification and parental counseling. **METHODS:** Patients under 2 years of age in National Surgical Quality Improvement Project Pediatric Database (NSQIP-P) from 2012 to 2016 who underwent primary cleft palate repair were identified. Risk factors for adverse events after cleft palate repair were identified. **RESULTS:** Outcomes for 4989 patients were reviewed. Mean age was 1.0±0.3 years and 53.5% were males. Adverse events occurred in 6.4% (320) of patients. The wound dehiscence rate was 3.1%, and the reoperation rate was 0.9%. On multivariate analysis, perioperative blood transfusion (adjusted odds ratio [aOR] 30.2), bronchopulmonary dysplasia/chronic lung disease (aOR 2.2), and prolonged length of stay (LOS) (aOR 1.1) were significantly associated with an adverse event. When subdivided by type of adverse event, reoperation was associated with perioperative blood transfusion (aOR 286.5), cerebral palsy (aOR 11.3), and prolonged LOS (aOR 1.1). Thirty-day readmission was associated with American Society of Anesthesiologists Physical Status Classification class III (aOR 2.0) and IV (aOR 4.8), bronchopulmonary dysplasia/chronic lung disease (aOR 2.5), cerebral palsy (aOR 5.7), and prolonged LOS (aOR 1.1). Finally, wound dehiscence was significantly associated with perioperative blood transfusion only (aOR 8.2). **CONCLUSIONS:** Although adverse events following cleft palate surgery are rare, systemic disease remains the greatest predictor for readmission and reoperation. Neurologic and pulmonary diseases are the greatest systemic risk factors. Intraoperative adverse events requiring blood transfusion are the greatest surgical risk factor for post-surgical complications.

PMID: [31299734](#)**27. Incidence and predictors of postoperative pulmonary complications in patients undergoing craniotomy and excision of posterior fossa tumor.**

Hooda B, Chouhan RS, Rath GP, Lamsal R, Bithal PK.

J Anaesthesiol Clin Pharmacol. 2019 Apr-Jun;35(2):254-260. doi: 10.4103/joacp.JOACP_350_17.

BACKGROUND AND AIMS: Infratentorial neurosurgical procedures are considered high risk for the development of postoperative pulmonary complications (POPCs), prolonging hospital stay of patients with substantial morbidity and mortality. **MATERIAL AND METHODS:** Patients between the ages of 18 and 65 years, who underwent elective surgery for posterior fossa tumors over a period of two years, were reviewed. Data including American Society of Anesthesiologists physical status; comorbidities like hypertension, diabetes mellitus and hypothyroidism, history of smoking, obstructive sleep apnea, respiratory symptoms, lower cranial nerve (LCN) palsy; intraoperative complications such as hemodynamic alterations suggestive of brain

stem or cranial nerve handling, tight brain as informed by the operating neurosurgeon, blood loss, and transfusion; and postoperative duration of mechanical ventilation, tracheostomy, POPCs, length of ICU and hospital stay, general condition of the patient at discharge, and cause of in-hospital mortality were collected. POPC was defined as the presence of atelectasis, tracheobronchitis, pneumonia, bronchospasm, respiratory failure, reintubation, or weaning failure. RESULTS: Case files of 288 patients fulfilling the study criteria were analyzed; POPCs were observed in 35 patients (12.1%). On multivariate analysis, postoperative blood transfusion, LCN palsy, prolonged ICU stay, and tracheostomy were found to be independent predictors of POPC. CONCLUSIONS: The incidence of POPC was 12.1% following infratentorial tumor surgery. The predictors for the occurrence of POPCs were postoperative blood transfusion, LCN palsy, prolonged ICU stay, and tracheostomy.

PMID: [31303718](#)

28. A case of hypoxic encephalopathy induced by the inhalation of helium that resolved with no neurological complications: a case report and analysis of similar cases.

Ogura K, Takahashi W, Morita Y.

Acute Med Surg. 2019 Apr 2;6(3):308-311. doi: 10.1002/ams2.414. eCollection 2019 Jul.

BACKGROUND: Nowadays, it is getting easier to search information about helium-assisted suicide online. Therefore, healthcare professionals must understand helium-associated medical conditions. CASE PRESENTATION: A 27-year-old man was found with his head covered with a bag connected to a helium tank. Hyperbaric oxygen therapy was not given because his head computed tomography showed no cerebral vasculature air embolism and there was no obvious limb paralysis. The diagnosis was impaired consciousness with hypoxic encephalopathy; he needed mechanical ventilation for 2 days. He was discharged after intelligence tests with no obvious higher brain dysfunction. CONCLUSION: We successfully treated a patient with hypoxic encephalopathy due to helium inhalation. Our analysis suggests that the pathophysiology and appropriate intervention of helium intoxication might be different according to the devices used.

PMID: [31304035](#)

29. Quantifying deep grey matter atrophy using automated segmentation approaches: A systematic review of structural MRI studies.

Pagnozzi AM, Fripp J, Rose SE.

Neuroimage. 2019 Jul 15;116018. doi: 10.1016/j.neuroimage.2019.116018. [Epub ahead of print]

The deep grey matter (DGM) nuclei of the brain play a crucial role in learning, behaviour, cognition, movement and memory. Although automated segmentation strategies can provide insight into the impact of multiple neurological conditions affecting these structures, such as Multiple Sclerosis (MS), Huntington's disease (HD), Alzheimer's disease (AD), Parkinson's disease (PD) and Cerebral Palsy (CP), there are a number of technical challenges limiting an accurate automated segmentation of the DGM. Namely, the insufficient contrast of T1 sequences to completely identify the boundaries of these structures, as well as the presence of iso-intense white matter lesions or extensive tissue loss caused by brain injury. Therefore in this systematic review, 269 eligible studies were analysed and compared to determine the optimal approaches for addressing these technical challenges. The automated approaches used among the reviewed studies fall into three broad categories, atlas-based approaches focusing on the accurate alignment of atlas priors, algorithmic approaches which utilise intensity information to a greater extent, and learning-based approaches that require an annotated training set. Studies that utilise freely available software packages such as FIRST, FreeSurfer and LesionTOADS were also eligible, and their performance compared. Overall, deep learning approaches achieved the best overall performance, however these strategies are currently hampered by the lack of large-scale annotated data. Improving model generalisability to new datasets could be achieved in future studies with data augmentation and transfer learning. Multi-atlas approaches provided the second-best performance overall, and may be utilised to construct a "silver standard" annotated training set for deep learning. To address the technical challenges, providing robustness to injury can be improved by using multiple channels, highly elastic diffeomorphic transformations such as LDDMM, and by following atlas-based approaches with an intensity driven refinement of the segmentation, which has been done with the Expectation Maximisation (EM) and level sets methods. Accounting for potential lesions should be achieved with a separate lesion segmentation approach, as in LesionTOADS. Finally, to address the issue of limited contrast, R2*, T2* and QSM sequences could be used to better highlight the DGM due to its higher iron content. Future studies could look to additionally acquire these sequences by retaining the phase information from standard structural scans, or alternatively acquiring these sequences for only a training set, allowing models to learn the "improved" segmentation from T1-sequences alone.

PMID: [31319182](#)

30. Outcomes of Intrathecal Baclofen Therapy Compared With Deep Brain Stimulation in a Patient With Dystonic Cerebral Palsy: A Case Report.

Chae M, Hong S, Jung NY, Chang WS, Cho SR.

Ann Rehabil Med. 2019 Jun;43(3):335-340. doi: 10.5535/arm.2019.43.3.335. Epub 2019 Jun 28.

Deep brain stimulation (DBS) in internal globus pallidus is considered to be a good option for controlling generalized dystonia in patients with this condition. In this relation, it is known that DBS has already been shown to have significant effects on primary dystonia, but is seen as controversial in secondary dystonia including cerebral palsy (CP). On the other hand, intrathecal baclofen (ITB) has been known to reduce spasticity and dystonia in patients who did not respond to oral medications or botulinum toxin treatment. Here, we report a patient with dystonic CP, who received the ITB pump implantation long after the DBS and who noted remarkable improvement in the 36-Item Short Form Health Survey, Dystonia Rating Scale, Modified Barthel Index, and visual analog scale scores for pain after an ITB pump implantation was used as compared with DBS. To our knowledge, the present case report is the first to demonstrate the effects of an ITB pump on reducing pain and dystonia and improving quality of life and satisfaction, compared with DBS in a patient with CP.

PMID: [31311256](#)

31. Prevalence of Cerebral Palsy in Indian Children: A Systematic Review and Meta-Analysis.

Chauhan A, Singh M, Jaiswal N, Agarwal A, Sahu JK, Singh M.

Indian J Pediatr. 2019 Jul 13. doi: 10.1007/s12098-019-03024-0. [Epub ahead of print]

OBJECTIVE: To determine the pooled-prevalence of cerebral palsy in Indian children. **METHODS:** The authors searched the published literature from different databases (PubMed, Ovid SP and EMBASE) and also tried to acquire information from the unpublished literature about the prevalence of cerebral palsy. They screened prospective/retrospective, cross-sectional, and cohort studies of children with cerebral palsy in the Indian population. Data were extracted from the included studies, and quality assessment was performed. Data were analysed using STATA MP12 (Texas, College Station). **RESULTS:** Of the 862 publications searched, eight studies were qualified and included for quantitative analysis. The overall pooled prevalence of cerebral palsy per 1000 children surveyed was 2.95 (95% CI 2.03-3.88). Sub-group analysis for rural, urban and mixed rural-urban study population demonstrated the pooled prevalence as 1.83 (95% CI 0.41-3.25), 2.29 (95% CI 1.43-3.16) and 4.37 (95% CI 2.24-6.51) respectively. **CONCLUSIONS:** This systematic review observed a paucity of high-quality, prevalence studies of cerebral palsy in India, which is a limitation to estimate the inferences for a national estimate. The observed prevalence of cerebral palsy in India is near similar to global estimates. There is a need to re-allocate resources and revisit the implementation of the existing policies for the prevention and management of cerebral palsy, taking into account the current disease burden.

PMID: [31300955](#)

32. Neurodevelopment at 2 years corrected age among Vietnamese preterm infants.

Do CHT, Kruse AY, Wills B, Sabanathan S, Clapham H, Pedersen FK, Pham TN, Vu PM, Børresen ML.

Arch Dis Child. 2019 Jul 12. pii: archdischild-2019-316967. doi: 10.1136/archdischild-2019-316967. [Epub ahead of print]

BACKGROUND: Preterm infants are at risk of neurodevelopmental delay, but data on long-term outcomes in low-income and middle-income countries remain scarce. **OBJECTIVES:** To examine neurodevelopment using Bayley Scales of Infant and Toddler Development-3rd edition (Bayley-III) and neurological findings in 2-year-old preterm infants, and to compare with healthy Vietnamese infants. Further, to assess factors associated with neurodevelopmental impairment. **DESIGN AND SETTING:** Cohort study to follow up preterm infants discharged from a neonatal intensive care unit (NICU) of a tertiary children's hospital in Vietnam. **PARTICIPANTS:** Infants born at <37 weeks of gestational age. **MAIN OUTCOMES:** Bayley-III assessment and neurological examination at 2-year corrected age (CA) compared with healthy Vietnamese infants. **RESULTS:** Of 294 NICU preterm infants, Bayley-III scores of all 184/243 (76%) survivors at 2 years CA were significantly lower than those of healthy Vietnamese peers in all three domains: cognition (mean (SD): 84.5 (8.6) vs 91.4 (7.5), $p<0.001$), language (mean (SD): 88.7 (12.5) vs 95.9 (11.9), $p<0.001$) and motor (mean (SD): 93.1 (9.0) vs 96.8 (9.3), $p=0.003$). The mean differences in Bayley-III scores between preterm and healthy Vietnamese infants were -6.9 (-9.1 to -4.7), -7.2 (-10.5 to -3.8) and -3.7 (-6.1 to -1.2) for cognitive, language and motor scores, respectively. The prevalence of neurodevelopmental impairment was 17% for cognitive, 8% for language and 4% for motor performance. In total, 7% were diagnosed with cerebral

palsy. Higher maternal education was positively associated with infant neurodevelopment (OR 0.32, 95% CI 0.11 to 0.94). **CONCLUSIONS:** Vietnamese preterm infants in need of neonatal intensive care showed poor neurodevelopment at 2 years. Higher maternal education was positively associated with infant neurodevelopment. Standard follow-up programmes for preterm infants should be considered in low-resource settings.

PMID: [31300408](#)

33. The experience of carers of children with Cerebral Palsy living in rural areas of Ghana who have received no rehabilitation services: A qualitative study.

Nyante GG, Carpenter C.

Child Care Health Dev. 2019 Jul 19. doi: 10.1111/cch.12706. [Epub ahead of print]

PMID: [31322764](#)

34. Cerebral Palsy in North Indian Children: Clinico-etiological Profile and Comorbidities.

Bhati P, Sharma S, Jain R, Rath B, Beri S, Gupta VK, Aneja S.

J Pediatr Neurosci. 2019 Jan-Mar;14(1):30-35. doi: 10.4103/jpn.JPN_46_18.

AIMS AND OBJECTIVES: Cerebral palsy (CP) is a common motor disability in children. This study aimed at elaborating various comorbidities and etiologies and also at correlating motor disability with other disabilities. **MATERIAL AND METHODS:** This hospital-based study was conducted in the outpatient department of a tertiary care hospital in Delhi on 160 children with CP in the age group 2-15 years. A detailed history taking and examination were conducted for each patient and appropriate investigations were performed. **RESULTS:** Most patients, that is 64.4%, were younger than 5 years of age and 72.5% were males. Most common etiology was birth asphyxia (41.9%). Maximum patients were of bilateral spastic (spastic quadriplegic) CP accounting 43.1%. Intellectual disability was the most common comorbidity across all subtypes of CP followed by epilepsy. Comorbidities such as epilepsy and all visual problems except optic atrophy were more common in spastic quadriplegic CP. Hearing, speech impairment, and optic atrophy were more common in dyskinetic CP. Chewing, swallowing, and drooling problems were more common in spastic quadriplegic CP. **CONCLUSION:** Most common risk factor of CP is birth asphyxia; thus, by improving health care facilities, its incidence can be reduced. CP affects not only motor functions but also other important functions of body as well, and the more severe the motor disabilities, the more are other comorbidities and their intensity also increases with that of the intensity of brain insult.

PMID: [31316640](#)

Prevention and Cure

35. Human Cord Blood-Derived Unrestricted Somatic Stem Cell Infusion Improves Neurobehavioral Outcome in a Rabbit Model of Intraventricular Hemorrhage.

Vinukonda G, Liao Y, Hu F, Ivanova L, Purohit D, Finkel DA, Giri P, Bapatla L, Shah S, Zia MT, Hussein K, Cairo MS, La Gamma EF.

Stem Cells Transl Med. 2019 Jul 19. doi: 10.1002/sctm.19-0082. [Epub ahead of print]

Intraventricular hemorrhage (IVH) is a severe complication of preterm birth, which leads to hydrocephalus, cerebral palsy, and mental retardation. There are no available therapies to cure IVH and standard treatment is supportive care. Unrestricted somatic stem cells (USSCs) from human cord blood have reparative effects in animal models of brain and spinal cord injuries. USSCs were administered to premature rabbit pups with IVH and their effects on white matter integrity and neurobehavioral performance were evaluated. USSCs were injected either via intracerebroventricular (ICV) or via intravenous (IV) routes in 3 days premature (term 32d) rabbit pups, 24 hours after glycerol-induced IVH. The pups were sacrificed at postnatal days 3, 7, and 14 and effects were compared to glycerol-treated but unaffected or nontreated control. Using in vivo live bioluminescence imaging and immunohistochemical analysis, injected cells were found in the injured parenchyma on day 3 when using the IV route compared to ICV where cells were found adjacent to the ventricle wall forming aggregates; we did not observe any

adverse events from either route of administration. The injected USSCs were functionally associated with attenuated microglial infiltration, less apoptotic cell death, fewer reactive astrocytes, and diminished levels of key inflammatory cytokines (TNF α and IL1 β). In addition, we observed better preservation of myelin fibers, increased myelin gene expression, and altered reactive astrocyte distribution in treated animals, and this was associated with improved locomotor function. Overall, our findings support the possibility that USSCs exert anti-inflammatory effects in the injured brain mitigating many detrimental consequences associated with IVH. *Stem Cells Translational Medicine* 2019.

PMID: [31322326](#)

36. The microbiota protects from viral-induced neurologic damage through microglia-intrinsic TLR signaling.

Brown DG, Soto R, Yandamuri S, Stone C, Dickey L, Gomes-Neto JC, Pastuzyn ED, Bell R, Petersen C, Buhrke K, Fujinami RS, O'Connell RM, Stephens WZ, Shepherd JD, Lane TE, Round JL.

Elife. 2019 Jul 16;8. pii: e47117. doi: 10.7554/eLife.47117.

Symbiotic microbes impact the function and development of the central nervous system (CNS); however, little is known about the contribution of the microbiota during viral-induced neurologic damage. We identify that commensals aid in host defense following infection with a neurotropic virus through enhancing microglia function. Germfree mice or animals that receive antibiotics are unable to control viral replication within the brain leading to increased paralysis. Microglia derived from germfree or antibiotic-treated animals cannot stimulate viral-specific immunity and microglia depletion leads to worsened demyelination. Oral administration of toll-like receptor (TLR) ligands to virally infected germfree mice limits neurologic damage. Homeostatic activation of microglia is dependent on intrinsic signaling through TLR4, as disruption of TLR4 within microglia, but not the entire CNS (excluding microglia), leads to increased viral-induced clinical disease. This work demonstrates that gut immune-stimulatory products can influence microglia function to prevent CNS damage following viral infection.

PMID: [31309928](#)

37. Repression of the Glucocorticoid Receptor Increases Hypoxic-Ischemic Brain Injury in the Male Neonatal Rat.

Knox-Concepcion KR, Figueroa JD, Hartman RE, Li Y, Zhang L.

Int J Mol Sci. 2019 Jul 16;20(14). pii: E3493. doi: 10.3390/ijms20143493.

Hypoxic-ischemic encephalopathy (HIE) resulting from asphyxia is the most common cause of neonatal brain damage and results in significant neurological sequelae, including cerebral palsy. The current therapeutic interventions are extremely limited in improving neonatal outcomes. The present study tests the hypothesis that the suppression of endogenous glucocorticoid receptors (GRs) in the brain increases hypoxic-ischemic (HI) induced neonatal brain injury and worsens neurobehavioral outcomes through the promotion of increased inflammation. A mild HI treatment of P9 rat pups with ligation of the right common carotid artery followed by the treatment of 8% O₂ for 60 min produced more significant brain injury with larger infarct size in female than male pups. Intracerebroventricular injection of GR siRNAs significantly reduced GR protein and mRNA abundance in the neonatal brain. Knockdown of endogenous brain GRs significantly increased brain infarct size after HI injury in male, but not female, rat pups. Moreover, GR repression resulted in a significant increase in inflammatory cytokines TNF- α and IL-10 at 6 h after HI injury in male pups. Male pups treated with GR siRNAs showed a significantly worsened reflex response and exhibited significant gait disturbances. The present study demonstrates that endogenous brain GRs play an important role in protecting the neonatal brain from HI induced injury in male pups, and suggests a potential role of glucocorticoids in sex differential treatment of HIE in the neonate.

PMID: [31315247](#)