

Monday 19 February 2018

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 research.cerebralpalsy.org.au

Professor Nadia Badawi AM

Macquarie Group Foundation Chair of Cerebral Palsy

[Subscribe to CP Research News](#)

Please note: This research bulletin represents only the search results for cerebral palsy and related neurological research as provided by the PubCrawler service. The articles listed below do not represent the views of Cerebral Palsy Alliance.

Interventions and Management

1. Validation of reaching in a virtual environment in typically developing children and children with mild unilateral cerebral palsy.

Robert MT, Levin MF.

Dev Med Child Neurol. 2018 Feb 10. doi: 10.1111/dmcn.13688. [Epub ahead of print]

AIM: To compare three reaching movements made in two planes between a low-cost, game-based virtual reality and a matched physical environment in typically developing children and children with cerebral palsy (CP). To determine if differences in kinematics are related to sensory deficits. **METHOD:** An observational study in which 27 children (typically developing, n=17, mean age 13y, [SD] 2y 2mo, range 9y 3mo-17y 2mo; CP, n=10, mean age 13y 8mo, [SD] 1y 8mo, range 11y 1mo-17y 1mo, Manual Ability Classification System levels I-II) performed 15 trials of three gestures in each of a virtual reality and a matched physical environment. Upper-limb and trunk kinematics were recorded using an electromagnetic system (G4, Polhemus, six markers, 120Hz). **RESULTS:** Compared to the physical environment, movements in virtual reality made by typically developing children were slower ($p=0.002$), and involved less trunk flexion ($p=0.002$) and rotation ($p=0.026$). Children with CP had more curved trajectories ($p=0.005$) and used less trunk flexion ($p=0.003$) and rotation ($p=0.005$). Elbow and shoulder kinematics differed from 2.8% to 155.4% between environments in both groups. Between groups, there were small, clinically insignificant differences with only the vertical gesture being longer in typically developing children. Children with CP who had greater tactile impairment used more trunk displacement. **INTERPRETATION:** Clinicians and researchers need to be aware of differences in movement variables when setting goals or designing protocols for improving reaching in children with CP using low-cost, game-based virtual reality systems. **WHAT THIS PAPER ADDS:** Upper-limb kinematics differed in each group when reaching in physical versus virtual environments. There were small differences in movements made by children with mild unilateral cerebral palsy (CP) compared to typically developing children. Differences in reaching kinematics should be considered when goal setting using virtual reality interventions for children with mild unilateral CP.

[PMID: 29427357](#)

2. Changes in Tactile Function During Intensive Bimanual Training in Children With Unilateral Spastic Cerebral Palsy.

Saussez G, Van Laethem M, Bleyenheuft Y.

J Child Neurol. 2018 Mar;33(4):260-268. doi: 10.1177/0883073817753291.

Recently, an intensive bimanual intervention using sensory enriched materials resulted in improved tactile function in children with unilateral spastic cerebral palsy (USCP), raising the question of whether the observed tactile function improvement was due to the sensory enriched environment or the bimanual intervention per se. The present study investigates whether a bimanual intensive intervention improves tactile function. Nineteen children with USCP received 90 hours of bimanual training without enriched environment. Primary outcomes: Manual Form Perception Test/MFPT, Grating Orientation Task/GOT. Children were assessed before, after the training, and at the 4-month follow-up. Significant improvements were observed in MFPT for the more affected hand ($P = .015$). Larger stereognosis/MFPT improvements correlated with poorer baseline motor function. Intensive bimanual training alone was sufficient to improve stereognosis, though no improvement in

GOT was observed. Present and previously published findings suggest that environmental tactile enrichment incorporated into a bimanual motor training may be needed to improve spatial discrimination/GOT in children with USCP.

[PMID: 29433419](#)

3. Severity of cerebral palsy and likelihood of adverse events after botulinum toxin A injections.

Swinney CM, Bau K, Burton KL, O'Flaherty SJ, Bear NL, Paget SP.

Dev Med Child Neurol. 2018 Feb 16. doi: 10.1111/dmcn.13686. [Epub ahead of print]

AIM: To determine the incidence of common adverse events after botulinum toxin A (BoNT-A) injections in children with cerebral palsy (CP) and to identify whether the severity of CP influences the incidence of adverse events. **METHOD:** This was an observational study of patients attending a BoNT-A clinic at a tertiary paediatric hospital (2010-2014). Data examined included procedural adverse events at the time of injection and at follow-up. Systemic adverse events were defined as lower respiratory tract illnesses, generalized weakness, dysphagia, and death. Severity of CP was categorized by the Gross Motor Function Classification System (GMFCS). The relationships between GMFCS and adverse events were analysed using negative binomial regression models. **RESULTS:** In total, 591 children underwent 2219 injection episodes. Adverse events were reported during the procedure (130 [6%] injection episodes) and at follow-up (492 [22%] injection episodes). There were significantly increased rates of systemic adverse events in injection episodes involving children in GMFCS level IV (incidence rate ratio [IRR] 3.92 [95% confidence interval] 1.45-10.57) and GMFCS level V (IRR 7.37 [95% confidence interval 2.90-18.73]; $p < 0.001$). **INTERPRETATION:** Adverse events after BoNT-A injections are common but mostly mild and self-limiting. Children in GMFCS levels IV and V are at increased risk of systemic adverse events. The relationship between CP severity and BoNT-A adverse events is complex and further research is required to better understand this relationship. **WHAT THIS PAPER ADDS:** Adverse events reported at the time of botulinum toxin A injection occurred in 6% of injection episodes. Adverse events were reported at follow-up in 22% of injection episodes. Children in Gross Motor Function Classification System (GMFCS) levels IV and V have increased rates of systemic adverse events. Children in GMFCS levels IV and V report less local weakness and pain.

[PMID: 29451702](#)

4. Non-neural Muscle Weakness Has Limited Influence on Complexity of Motor Control during Gait.

Goudriaan M, Shuman BR, Steele KM, Van den Hauwe M, Goemans N, Molenaers G, Desloovere K.

Front Hum Neurosci. 2018 Jan 31;12:5. doi: 10.3389/fnhum.2018.00005. eCollection 2018.

Cerebral palsy (CP) and Duchenne muscular dystrophy (DMD) are neuromuscular disorders characterized by muscle weakness. Weakness in CP has neural and non-neural components, whereas in DMD, weakness can be considered as a predominantly non-neural problem. Despite the different underlying causes, weakness is a constraint for the central nervous system when controlling gait. CP demonstrates decreased complexity of motor control during gait from muscle synergy analysis, which is reflected by a higher total variance accounted for by one synergy (tVAF1). However, it remains unclear if weakness directly contributes to higher tVAF1 in CP, or whether altered tVAF1 reflects mainly neural impairments. If muscle weakness directly contributes to higher tVAF1, then tVAF1 should also be increased in DMD. To examine the etiology of increased tVAF1, muscle activity data of gluteus medius, rectus femoris, medial hamstrings, medial gastrocnemius, and tibialis anterior were measured at self-selected walking speed, and strength data from knee extensors, knee flexors, dorsiflexors and plantar flexors, were analyzed in 15 children with CP [median (IQR) age: 8.9 (2.2)], 15 boys with DMD [8.7 (3.1)], and 15 typical developing (TD) children [8.6 (2.7)]. We computed tVAF1 from 10 concatenated steps with non-negative matrix factorization, and compared tVAF1 between the three groups with a Mann-Whitney U-test. Spearman's rank correlation coefficients were used to determine if weakness in specific muscle groups contributed to altered tVAF1. No significant differences in tVAF1 were found between DMD [tVAF1: 0.60 (0.07)] and TD children [0.65 (0.07)], while tVAF1 was significantly higher in CP [(0.74 (0.09)] than in the other groups (both $p < 0.005$). In CP, weakness in the plantar flexors was related to higher tVAF1 ($r = -0.72$). In DMD, knee extensor weakness related to increased tVAF1 ($r = -0.50$). These results suggest that the non-neural weakness in DMD had limited influence on complexity of motor control during gait and that the higher tVAF1 in children with CP is mainly related to neural impairments caused by the brain lesion.

[PMID: 29445330](#)

5. Virtual reality training for children with unilateral cerebral palsy.

Hung YC, Gordon AM.

Dev Med Child Neurol. 2018 Feb 14. doi: 10.1111/dmcn.13699. [Epub ahead of print]

[This commentary is on the original article by Robert and Levin.]

[PMID: 29442357](#)

6. Bike skills training for children with cerebral palsy: protocol for a randomised controlled trial.

Toovey R, Harvey AR, McGinley JL, Lee KJ, Shih STF, Spittle AJ.

BMJ Open. 2018 Feb 3;8(2):e019898. doi: 10.1136/bmjopen-2017-019898.

INTRODUCTION: Two-wheel bike riding can be a goal for children with cerebral palsy (CP) and a means of participating in physical activity. It is possible for some children with CP to ride a two-wheel bike; however, currently far fewer can ride compared with their typically developing peers. Evidence supports training targeted towards goals of the child with CP and their family; yet there is little evidence to guide best-practice bike skills training. Task-specific training may lead to attainment of two-wheel bike-specific goals. This study aims to determine if a novel task-specific approach to training two-wheel bike skills is more effective than a parent-led home programme for attaining individualised two-wheel bike-specific goals in independently ambulant children with CP aged 6-15 years. **METHODS AND ANALYSIS:** Sixty eligible children with CP (Gross Motor Function Classification System levels I-II) aged 6-15 years with goals relating to riding a two-wheel bike will be randomised to either a novel task-specific centre-based group programme (intervention) or a parent-led home-based programme (comparison), both involving a 1-week intervention period. The primary outcome is goal attainment in the week following the intervention period (T1). Secondary outcomes include: goal attainment and participation in physical activity at 3 months postintervention (T2) and bike skills, attendance and involvement in bike riding, self-perception and functional skills at T1 and T2. Economic appraisal will involve cost-effectiveness and cost-utility analyses. Adherence of clinicians and parents to the intervention and comparison protocols will be assessed. Linear and logistic regression will be used to assess the effect of the intervention, adjusted for site as used in the randomisation process. **ETHICS AND DISSEMINATION:** This study was approved by the Human Research and Ethics Committees at The Royal Children's Hospital (#36209). Results will be disseminated via peer-reviewed publications and conference presentations.

[PMID: 29431140](#)

7. Commentary Regarding "Caregiver Perceptions and Health-Related Quality-of-Life Changes in Cerebral Palsy Patients After Spinal Arthrodesis".

Haher TR.

Spine (Phila Pa 1976). 2018 Feb 12. doi: 10.1097/BRS.0000000000002560. [Epub ahead of print]

[No abstract available]

[PMID: 29438220](#)

8. The treatment of femoral fractures in children with cerebral palsy.

Persiani P, Murgia M, Ranaldi FM, Mazza O, Mariani M, Crostelli M, Villani C.

Clin Ter. 2018 Jan-Feb;169(1):e18-e22. doi: 10.7417/T.2018.2049.

OBJECTIVE: The purpose of this study is to retrospectively evaluate a group of children affected by cerebral palsy with a recent femoral fracture, and to analyse the results and complications in relation to the treatment used. **MATERIALS AND METHODS:** The analysis was performed on 36 children (21 M, 15 F, 8-14 years old) with cerebral palsy (7 diplegia, 28 tetraparesis, 1 hemiplegia) with a metaphyseal or a diaphyseal femoral fracture. The patients were subdivided into two groups according to their Gross Motor Function Classification System (GMFCS) level: level 2-3 (9 patients) and level 4-5 (27 patients), evaluating the presence of complications and malunions for each group at the end of each follow up. **RESULTS:** The fractures were displaced in 24 patients and nondisplaced in 12 patients. In 26 cases the treatment involved a closed reduction

and immobilisation in a long leg hip spica cast for 7 weeks, while in 10 cases the treatment involved an open reduction-internal fixation (ORIF) followed by a 3-week period in a plaster coated fracture bandage. CONCLUSIONS: Taking into consideration the maximum possible recovery of function, an ORIF is preferable to prevent malunion, particularly in distal metaphysis and distal shaft fractures. In the GMFCS level 2-3 patients, surgery has allowed to recover, or at least maintain, the pre-fracture functional level, while in patients with GMFCS level 4-5, it has allowed to reduce the immobilisation times and prevent the development of decubitus lesions.

[PMID: 29446787](#)

9. Knee contracture in children with cerebral palsy: association with muscle lengths.

Van Campenhout A, Bar-On L.

Dev Med Child Neurol. 2018 Feb 16. doi: 10.1111/dmcn.13690. [Epub ahead of print]

[This commentary is on the original article by Cloudt et al.]

[PMID: 29451692](#)

10. The influence of lower limb impairments on RaceRunning performance in athletes with hypertonia, ataxia or athetosis.

van der Linden ML, Jahed S, Tennant N, Verheul MHG.

Gait Posture. 2018 Feb 5;61:362-367. doi: 10.1016/j.gaitpost.2018.02.004. [Epub ahead of print]

OBJECTIVES: RaceRunning enables athletes with limited or no walking ability to propel themselves independently using a three-wheeled running bike that has a saddle and a chest plate for support but no pedals. For RaceRunning to be included as a Para athletics event, an evidence-based classification system is required. Therefore, the aim of this study was to assess the association between a range of impairment measures and RaceRunning performance. METHODS: The following impairment measures were recorded: lower limb muscle strength assessed using Manual Muscle Testing (MMT), selective voluntary motor control assessed using the Selective Control Assessment of the Lower Extremity (SCALE), spasticity recorded using both the Australian Spasticity Assessment Score (ASAS) and Modified Ashworth Scale (MAS), passive range of motion (ROM) of the lower extremities and the maximum static step length achieved on a stationary bike (MSSL). Associations between impairment measures and 100-meter race speed were assessed using Spearman's correlation coefficients. RESULTS: Sixteen male and fifteen female athletes (27 with cerebral palsy), aged 23 (SD = 7) years, Gross Motor Function Classification System levels ranging from II to V, participated. The MSSL averaged over both legs and the ASAS, MAS, SCALE, and MMT summed over all joints and both legs, significantly correlated with 100 m race performance (ρ : 0.40-0.54). Passive knee extension was the only ROM measure that was significantly associated with race speed (ρ = 0.48). CONCLUSION: These results suggest that lower limb spasticity, isometric leg strength, selective voluntary motor control and passive knee extension impact performance in RaceRunning athletes. This supports the potential use of these measures in a future evidence-based classification system.

[PMID: 29433091](#)

11. The Pediatric SmartShoe: Wearable Sensor System for Ambulatory Monitoring of Physical Activity and Gait.

Hegde N, Zhang T, Uswatte G, Taub E, Barman J, McKay S, Taylor A, Morris DM, Griffin A, Sazonov ES.

IEEE Trans Neural Syst Rehabil Eng. 2018 Feb;26(2):477-486. doi: 10.1109/TNSRE.2017.2786269.

Cerebral palsy (CP) is a group of nonprogressive neuro-developmental conditions occurring in early childhood that causes movement disorders and physical disability. Measuring activity levels and gait patterns is an important aspect of CP rehabilitation programs. Traditionally, such programs utilize commercially available laboratory systems, which cannot be utilized in community living. In this study, a novel, shoe-based, wearable sensor system (pediatric SmartShoe) was tested on 11 healthy children and 10 children with CP to validate its use for monitoring of physical activity and gait. Novel data processing techniques were developed to remove the effect of orthotics on the sensor signals. Machine learning models were developed to automatically classify the activities of daily living. The temporal gait parameters estimated from the SmartShoe data were compared against reference measurements on a GAITRite mat. A leave-one-out cross-validation method indicated a 95.3% average accuracy of activity classification (for sitting, standing, and walking) for children with CP and 96.2% for healthy children. Average relative errors in gait parameter estimation (gait cycle, stance, swing, and step time, % single support time on

both lower extremities, along with cadence) ranged from 0.2% to 6.4% (standard deviation range = 1.4%-9.9%). These results suggest that the pediatric SmartShoe can accurately measure physical activity and gait of children with CP and can potentially be used for ambulatory monitoring.

[PMID: 29432115](#)

12. Functional capacity in adults with cerebral palsy: Lower limb muscle strength matters.

Gillett JG, Lichtwark GA, Boyd RN, Barber LA.

Arch Phys Med Rehabil. 2018 Feb 10. pii: S0003-9993(18)30094-7. doi: 10.1016/j.apmr.2018.01.020. [Epub ahead of print]

OBJECTIVE: To investigate the relationship between lower limb muscle strength, passive muscle properties and functional capacity outcomes in adults with cerebral palsy (CP). **DESIGN:** Cross-sectional study. **SETTING:** Tertiary institution biomechanics laboratory. **PARTICIPANTS:** Sample of 33 adults with spastic-type CP with a mean age of 25 (range, 15-51) years; mean \pm SD body mass 70.15 ± 21.35 kg; Gross Motor Function Classification System (GMFCS) level I n=20, level II n=13. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Six-minute walk test (6MWT) distance (m); lateral step-up (LSU) test performance (total repetitions); timed up-stairs (TUS) performance (s); maximum voluntary isometric strength of plantar flexors (PF) and dorsiflexors (DF) (Nm.kg⁻¹); and passive ankle joint and muscle stiffness. **RESULTS:** Maximum isometric PF strength independently explained 61% of variance in 6MWT performance; 57% of variance in LSU test performance; and 50% of variance in TUS test performance. GMFCS level was significantly and independently related to all three functional capacity outcomes, and age was retained as a significant independent predictor of LSU, and TUS test performance. Passive medial gastrocnemius muscle fascicle stiffness and ankle joint stiffness were not significantly related to functional capacity measures in any of the multiple regression models. **CONCLUSIONS:** Low isometric PF strength was the most important independent variable related to distance walked on the 6MWT, fewer repetitions on the LSU test, and slower TUS test performance. These findings suggest lower isometric muscle strength contributes to the decline in functional capacity in adults with CP.

[PMID: 29438658](#)

13. Reliability of a clinical 3D freehand ultrasound technique: Analyses on healthy and pathological muscles.

Cenni F, Schless SH, Bar-On L, Aertbeliën E, Bruyninckx H, Hanssen B, Desloovere K.

Comput Methods Programs Biomed. 2018 Mar;156:97-103. doi: 10.1016/j.cmpb.2017.12.023. Epub 2017 Dec 22.

BACKGROUND AND OBJECTIVE: 3D freehand Ultrasonography is a medical imaging technique that can be used to measure muscle and tendon morphological and structural properties, including volume, lengths and echo-intensity. These properties are clinically relevant in neurological disorders such as spastic cerebral palsy to monitor disease progression and evaluate the effect of treatment. This study presents a methodology for extracting these parameters along with a clinical reliability analysis for the data acquisition and processing. **METHODS:** The medial gastrocnemius muscles and Achilles tendon of 10 typically developing children and 10 children with spastic cerebral palsy were assessed. An open-source in-house software library developed in Python (Py3DFreeHandUS) was used to reconstruct, into one 3D data set, the data simultaneously acquired from an US machine and a motion tracking system. US images were manually segmented and linearly interpolated by means of a new simplified approach which involved sequentially decreasing the total number of images used for muscle border segmentation from 100% to 5%. Acquisition and processing reliability was defined based on repeated measures from different data processors and from different data acquirers, respectively. **RESULTS:** When only 10% of the US images were outlined, there was an average underestimation of muscle volume of 1.1% and 1.6% with respect the computation of all the available images, for the typically developing and spastic cerebral palsy groups, respectively. For both groups, the reliability was higher for data processing than for data acquisition. High inter-class correlation coefficient values were found for processing and acquisition reliability, with worst case values of 0.89 and 0.61, respectively. The standard error of measurement, expressed as a percentage of the average volumes, was smaller than 2.6 ml (4.8%) in all cases. **CONCLUSIONS:** The present analysis demonstrates the effectiveness of applying 3D freehand ultrasonography in a clinical setting for analysing healthy and pathological paediatric muscle.

[PMID: 29428080](#)

14. Deep brain stimulation in cerebral palsy: Time for dynamism in a static encephalopathy.

Merola A, Fasano A.

Eur J Paediatr Neurol. 2018 Mar;22(2):221-222. doi: 10.1016/j.ejpn.2018.01.021.

[No abstract available]

[PMID: 29447767](#)

15. Determine the Relationship Between Abdominal Muscle Strength, Trunk Control and Urinary Incontinence in Children with Diplegic Cerebral Palsy.

Talu B.

Urol J. 2018 Feb 10. doi: 10.22037/uj.v0i0.4043. [Epub ahead of print]

PURPOSE: The aim of this study is to determine the relationship between abdominal muscle strength, trunk control and urinary incontinence in children with diplegic cerebral palsy. **MATERIALS AND METHODS:** The current study had a cross-sectional design using analytical study as well as an observational research model. Fifty children between the ages of 5 and 18 years who were diagnosed with diplegic clinical type of cerebral palsy were included in this study using improbable-random sampling method. After patients' demographic information were obtained, Dysfunctional Voiding and Incontinence Symptoms Score Questionnaire (DVISS), Dysfunctional Voiding Symptom Score (DVSS), the manual muscle test of the muscles, Trunk Control Test (TCT) and Trunk Control Measurement Scale (TCMS) were completed in order to evaluate trunk control. Also, Gross Motor Function Classification System (GMFCS) was performed in order to define the functional level. **RESULTS:** In this study, a highly correlated negative relationship was found between DVISS and DVSS scores with muscle abdominal strength, TCMS and TCT. In addition, a highly correlated positive relationship was found between both GMFCS and DVISS and GMFCS and DVSS. **CONCLUSION:** This is the first study that describes the effect of trunk control and muscle strength on urinary incontinence in children with diplegic cerebral palsy. This study showed that there is a correlation between trunk control, muscle strength and urinary incontinence.

[PMID: 29427287](#)

16. Percutaneous Salivary Gland Ablation using Ethanol in a Rat Model.

Burch E, Lubeley L, Murakami J.

J Oral Maxillofac Res. 2017 Dec 31;8(4):e3. doi: 10.5037/jomr.2017.8403. eCollection 2017 Oct-Dec.

OBJECTIVES: Sialorrhea is a common health and psychosocial problem for children with neuromuscular dysfunction secondary to a variety of disorders such as cerebral palsy. Current accepted treatments include the injection of botulinum toxin into the submandibular glands for temporary symptom relief. The purpose of this study is to demonstrate the feasibility of percutaneous ethanol injection for longer lasting salivary gland ablation in an animal model. **MATERIAL AND METHODS:** Twenty rats were used in this study. In each rat, 98% ethanol was injected into the right submandibular gland under ultrasound guidance. No intervention was performed on the left gland, which served as the control. Ten rats were sacrificed and glands evaluated at three weeks, with the remaining 10 rats sacrificed and evaluated at three months. Unpaired, 1-tailed T-tests were used to analyse the data. **RESULTS:** Ethanol injections induced a significant and sustained reduction in salivary gland size. Treated glands were 41% smaller by mass than untreated controls in the 10 rats sacrificed at three weeks ($P < 0.001$). Treated glands were 43% smaller by mass than untreated controls in the 10 rats sacrificed at three months ($P < 0.001$). Qualitative histologic analysis demonstrated extensive parenchymal damage, inflammation, and fibrosis at both three week and three month time points. **CONCLUSIONS:** Using a rat model, we demonstrated dramatic and sustained submandibular gland damage after percutaneous injection of ethanol.

[PMID: 29435205](#)

17. It is a long road to inclusive education for children with cerebral palsy.

Lebeer J.

Dev Med Child Neurol. 2018 Feb 14. doi: 10.1111/dmcn.13702. [Epub ahead of print]

[This commentary is on the original article by Gillies et al.]

[PMID: 29443388](#)

Prevention and Cure

18. Effect of Cord Blood Magnesium Level at Birth on Non-neurologic Neonatal Outcomes.

Edwards JM, Edwards LE, Swamy GK, Grotegut CA.

Am J Perinatol. 2018 Feb 12. doi: 10.1055/s-0038-1627097. [Epub ahead of print]

OBJECTIVE: We examined the effects of magnesium sulfate on non-neurologic neonatal outcomes with respect to cord blood magnesium level. **STUDY DESIGN:** We conducted a secondary analysis of the Maternal-Fetal Medicine Units Beneficial Effects of Antenatal Magnesium (MFMU BEAM) trial comparing the upper and lower quintiles of cord blood magnesium level. Outcomes included cerebral palsy (CP), necrotizing enterocolitis (NEC), retinopathy of prematurity (ROP), bronchopulmonary dysplasia (BPD), and assessments of mental and motor disability. Logistic regression was used to estimate adjusted odds ratios (aORs) of each outcome, controlling for gestational age (GA), birth weight, and treatment group (TG). **RESULTS:** A total of 1,254 women of the 2,444 included in the BEAM trial had cord blood magnesium levels recorded. GA and birth weight were lower and TG was more common in the upper quintile cohort ($p < 0.001$). Neonates in the upper quintile were more likely to have severe NEC (OR, 2.41, 95% confidence interval [CI]: 1.11-5.24), ROP (OR, 1.65, 95% CI: 1.05-2.59), and BPD (OR, 1.70, 95% CI: 1.04-2.73). Adjustment for covariates demonstrated no difference in the NEC, ROP, and BPD rates, although there was a decrease in rates of mental disability index < 70 which was not seen in the unadjusted analysis (aOR, 0.49, 95% CI: 0.25-0.99). **CONCLUSION:** Higher cord blood magnesium levels do not appear to have adverse non-neurologic effects on the neonate and may demonstrate improvement in neurologic outcomes.

[PMID: 29433145](#)**19. Neonatal Infection in Children With Cerebral Palsy: A Registry-Based Cohort Study.**

Smilga AS, Garfinkle J, Ng P, Andersen J, Buckley D, Fehlings D, Kirton A, Wood E, van Rensburg E, Shevell M, Oskoui M.

Pediatr Neurol. 2017 Dec 13. pii: S0887-8994(17)30847-0. doi: 10.1016/j.pediatrneurol.2017.11.006. [Epub ahead of print]

BACKGROUND: The goal of this study was to explore the association between neonatal infection and outcomes in children with cerebral palsy. **METHODS:** We conducted a retrospective cohort study using the Canadian CP Registry. Neonatal infection was defined as meeting one of the following criteria: (1) septicemia, (2) septic shock, or (3) administration of antibiotics for ≥ 10 days. Phenotypic profiles of children with cerebral palsy with and without an antecedent neonatal infection were compared. Subgroup analysis was performed, stratified by gestational age (term versus preterm). **RESULTS:** Of the 1229 registry participants, 505 (41.1%) were preterm, and 192 (15.6%) met the criteria for neonatal infection with 29% of preterm children having a neonatal infection compared with 6.5% in term-born children. Children with prior neonatal infection were more likely to have a white matter injury (odds ratio 2.2, 95% confidence interval 1.5 to 3.2), spastic diplegic neurological subtype (odds ratio 1.6, 95% confidence interval 1.1 to 2.3), and sensorineural auditory impairment (odds ratio 2.1, 95% confidence interval 1.4 to 3.3). Among preterm children, neonatal infection was not associated with a difference in phenotypic profile. Term-born children with neonatal infection were more likely to have spastic triplegia or quadriplegia (odds ratio 2.4, 95% confidence interval 1.3 to 4.3), concomitant white matter and cortical injury (odds ratio 4.1, 95% confidence interval 1.6 to 10.3), and more severe gross motor ability (Gross Motor Function Classification System IV to V) (odds ratio 2.6, 95% confidence interval 1.4 to 4.8) compared with preterm children. **CONCLUSIONS:** Findings suggest a role of systemic infection on the developing brain in term-born infants, and the possibility to develop targeted therapeutic and preventive strategies to reduce cerebral palsy morbidity.

[PMID: 29428154](#)

20. The continually changing epidemiology of cerebral palsy.

McIntyre S.

Acta Paediatr. 2018 Mar;107(3):374-375. doi: 10.1111/apa.14232.

[No abstract available]

[PMID: 29430775](#)

21. Preventing cerebral palsy in preterm labour: a multiorganisational quality improvement approach to the adoption and spread of magnesium sulphate for neuroprotection.

Burhouse A, Lea C, Ray S, Bailey H, Davies R, Harding H, Howard R, Jordan S, Menzies N, White S, Phillips K, Luyt K.

BMJ Open Qual. 2017 Oct 12;6(2):e000189. doi: 10.1136/bmjoq-2017-000189. eCollection 2017.

Magnesium sulphate has been demonstrated to be an effective neuroprotectant for babies delivered prematurely (under 37 weeks' gestational age). Antenatal administration reduces infant mortality and cerebral palsy (CP); however, uptake in the UK has been significantly lower than other countries. A quality improvement (QI) project (PREventing Cerebral palsy in Pre Term labour (PRECePT)) was carried out in the West of England, UK, to raise awareness of evidence and to improve the uptake of magnesium sulphate as neuroprotectant in preterm deliveries. Five National Health Service (NHS) Trusts and the West of England Academic Health Science Network participated in the QI project. The project was underpinned by a multifaceted QI approach that included: patient and clinical coproduction of resources; recruitment of clinical champions to support the local microsystems and create a stimulating/supporting environment for change; Plan, Do, Study, Act cycles; training for over 600 NHS staff and awareness raising and strategic influencing of key leaders. A baseline audit and regular measurement of the number of eligible women receiving magnesium sulphate was undertaken at each hospital site, and the overall programme was evaluated using data from an international benchmarking organisation for neonatal care outcomes-the Vermont Oxford Network. During the project 664 staff received magnesium sulphate training. The use of magnesium sulphate increased across the West of England from an average baseline of 21% over the 2 years preceding the project to 88% by the conclusion of the project. The project was also able to influence the development of a national data collection process for benchmarking the use of magnesium sulphate for neuroprotection in preterm deliveries in the U.K. PRECePT appears to have had a favourable effect on the uptake of magnesium sulphate across the West of England. The project has also provided learning about how to stimulate adoption and spread of evidence using a QI approach across a network.

[PMID: 29450301](#)

22. Re-engineering the interpretation of electronic fetal monitoring to identify reversible risk for cerebral palsy: a case control series.

Evans MI, Eden RD, Britt DW, Evans SM, Schiffrin BS.

J Matern Fetal Neonatal Med. 2018 Feb 15:1-191. doi: 10.1080/14767058.2018.1441283. [Epub ahead of print]

BACKGROUND: Even Key Opinion leaders now concede that electronic fetal monitoring (EFM) cannot reliably identify fetal acidemia which many vouch as the only labor mediated pathophysiologic precursor for cerebral palsy (CP). We have developed the "Fetal Reserve Index" - an algorithm combining five dynamic components of EFM (1. Rate, 2. Variability, 3. Accelerations, 4. Decelerations, and 5. Excessive uterine activity) considered individually that are combined with the presence of: 6. maternal, 7. obstetrical, and 8. fetal risk factors. **OBJECTIVE:** Here, we compare this 8-point fetal reserve index (FRI) against the performance of ACOG monograph criteria and ACOG Category systems for predicting risk for both CP and the need for emergency operative delivery (EOD). We then studied how varied management for screen positives (Red zone-defined below) impacts the outcome of such cases. **STUDY DESIGN:** Four hundred twenty term patients were studied: all entered labor with normal EFM's and no apparent cause of harm except events of labor and delivery. Sixty subsequently developed CP, and 360 were apparently normal controls. An FRI, normal on all 8 parameters scored 100%, 4 of 8 was 50%, etc. We divided cases into Green zone > 50%, Yellow 50-26%, and Red ≤ 25%. An FRI in the Red zone was considered a positive screen. We then compared performance metrics for the three evaluation schemes and differences between controls that reached Red against those controls whose worst scores were Green/Yellow. **RESULTS:** For detection of injury during labor, the FRI performed much better than the ACOG Category criteria (sensitivity 28%), and Category III (45%) (p < 0.001). All CP cases reached Red zone and were Red for a minimum of 2 hours (mean = 5.35 hours). Twenty-four% of controls reached Red, but were only Red for average of 1 hr. The incidence of low Apgar's, pH, FRI, and Lowest FRI increased progressively from Green/Yellow controls to red controls to CP cases. Irrespective, CP cases met ACOG Monograph criteria for labor injury less than 50% of the time. Only half of CP babies had umbilical artery pH values < 7.00, and less than 50% showed Category III patterns. The earlier in labor the Red zone was reached, the more likely for a baby to develop CP or the mother to require an

EOD regardless of fetal outcome. Successful intrauterine resuscitations (IR) diminished time spent in the Red zone and the need for EODs. CONCLUSIONS: FRI shows better discrimination for adverse fetal outcome and EOD than traditional EFM interpretation. The Category system is a very poor, subjective screening method as the vast majority of CP babies never reach the "action point" result of Category III. While reaching the Red zone does not ordain a bad outcome, how it is managed, does. Compared to CP cases, Red controls were delivered faster, had higher FRIs, and often had prompt management including IR maneuvers which improved the FRI and lowered the risk of EODs even for cases with normal outcomes. With further study and validation, the quantitative FRI approach may replace the current, very subjective interpretation with a quantitative "lab test" approach.

[PMID: 29447043](#)

23. Post-discharge body weight and neurodevelopmental outcomes among very low birth weight infants in Taiwan: A nationwide cohort study.

Hsu CT, Chen CH, Lin MC, Wang TM, Hsu YC.

PLoS One. 2018 Feb 14;13(2):e0192574. doi: 10.1371/journal.pone.0192574. eCollection 2018.

BACKGROUND: Premature infants are at high risk for developmental delay and cognitive dysfunction. Besides medical conditions, growth restriction is regarded as an important risk factor for cognitive and neurodevelopmental dysfunction throughout childhood and adolescence and even into adulthood. In this study, we analyzed the relationship between post-discharge body weight and psychomotor development using a nationwide dataset. **MATERIALS AND METHODS:** This was a nationwide cohort study conducted in Taiwan. Total of 1791 premature infants born between 2007 and 2011 with a birth weight of less than 1500 g were enrolled into this multi-center study. The data were obtained from the Taiwan Premature Infant Developmental Collaborative Study Group. The growth and neurodevelopmental evaluations were performed at corrected ages of 6, 12 and 24 months. Post-discharge failure to thrive was defined as a body weight below the 3rd percentile of the standard growth curve for Taiwanese children by the corrected age. **RESULTS:** The prevalence of failure to thrive was 15.8%, 16.9%, and 12.0% at corrected ages of 6, 12, and 24 months, respectively. At corrected ages of 24 months, 12.9% had low Mental Developmental Index (MDI) scores (MDI<70), 17.8% had low Psychomotor Developmental Index (PDI) scores (PDI<70), 12.7% had cerebral palsy, and 29.5% had neurodevelopmental impairment. Post-discharge failure to thrive was significantly associated with poor neurodevelopmental outcomes. After controlling for potential confounding factors (small for gestational age, extra-uterine growth retardation at discharge, cerebral palsy, gender, mild intraventricular hemorrhage, persistent pulmonary hypertension of newborn, respiratory distress syndrome, chronic lung disease, hemodynamic significant patent ductus arteriosus, necrotizing enterocolitis, surfactant use and indomethacin use), post-discharge failure to thrive remained a risk factor. **CONCLUSION:** This observational study observed the association between lower body weight at corrected age of 6, 12, and 24 months and poor neurodevelopmental outcomes among VLBW premature infants. There are many adverse factors which can influence the neurodevelopment in NICU care. More studies are needed to elucidate the causal relationship.

[PMID: 29444139](#)

24. Prediction of outcome in asphyxiated newborns treated with hypothermia: Is a MRI scoring system described before the cooling era still useful?

Al Amrani F, Marcovitz J, Sanon PN, Khairy M, Saint-Martin C, Shevell M, Wintermark P.

Eur J Paediatr Neurol. 2018 Jan 31. pii: S1090-3798(17)31784-1. doi: 10.1016/j.ejpn.2018.01.017. [Epub ahead of print]

AIM: To determine whether an MRI scoring system, which was validated in the pre-cooling era, can still predict the neurodevelopmental outcome of asphyxiated newborns treated with hypothermia at 2 years of age. **PATIENTS AND METHOD:** We conducted a retrospective cohort study of asphyxiated newborns treated with hypothermia. An MRI scoring system, which was validated in the pre-cooling era, was used to grade the severity of brain injury on the neonatal brain MRI. Their neurodevelopment was assessed around 2 years of age; adverse outcome included cerebral palsy, global developmental delay, and/or epilepsy. **RESULTS:** One hundred and sixty-nine newborns were included. Among the 131 newborns who survived and had a brain MRI during the neonatal period, 92% were evaluated around 2 years of age or later. Of these newborns, 37% displayed brain injury, and 23% developed an adverse outcome. Asphyxiated newborns treated with hypothermia who had an adverse outcome had a significantly higher MRI score ($p < 0.001$) compared to those without an adverse outcome. **CONCLUSION:** An MRI scoring system that was validated before the cooling era is still able to reliably differentiate which of the asphyxiated newborns treated with hypothermia were more prone to develop an adverse outcome around 2 years of age.

[PMID: 29439909](#)

25. Five and 10 minute Apgar scores and risks of cerebral palsy and epilepsy: population based cohort study in Sweden.

Persson M, Razaz N, Tedroff K, Joseph KS, Cnattingius S.

BMJ. 2018 Feb 7;360:k207. doi: 10.1136/bmj.k207.

OBJECTIVE: To investigate associations between Apgar score at five and 10 minutes across the entire range of score values (from 0 to 10) and risks of childhood cerebral palsy or epilepsy, and to analyse the effect of changes in Apgar scores from five to 10 minutes after birth in infants born ≥ 37 completed weeks. **DESIGN, SETTING, AND PARTICIPANTS:** Population based cohort study in Sweden, including 1 213 470 non-malformed live singleton infants, born at term between 1999 and 2012. Data on maternal and pregnancy characteristics and diagnoses of cerebral palsy and epilepsy were obtained by individual record linkages of nationwide Swedish registries. **EXPOSURES:** Apgar scores at five and 10 minutes. **MAIN OUTCOME MEASURE:** Cerebral palsy and epilepsy diagnosed up to 16 years of age. Adjusted hazard ratios were calculated, along with 95% confidence intervals. **RESULTS:** 1221 (0.1%) children were diagnosed as having cerebral palsy and 3975 (0.3%) as having epilepsy. Compared with children with an Apgar score of 10 at five minutes, the adjusted hazard ratio for cerebral palsy increased steadily with decreasing Apgar score: from 1.9 (95% confidence interval 1.6 to 2.2) for an Apgar score of 9 to 277.7 (154.4 to 499.5) for an Apgar score of 0. Similar and even stronger associations were obtained between Apgar scores at 10 minutes and cerebral palsy. Associations between Apgar scores and epilepsy were less pronounced, but increased hazard ratios were noted in infants with a five minute Apgar score of 7 or less and a 10 minute Apgar score of 8 or less. Compared with infants with an Apgar of 9-10 at both five and 10 minutes, hazard ratios of cerebral palsy and epilepsy were higher among infants with a five minute Apgar score of 7-8 and a 10 minute Apgar score of 9-10. **CONCLUSION:** Risks of cerebral palsy and epilepsy are inversely associated with five minute and 10 minute Apgar scores across the entire range of Apgar scores.

[PMID: 29437691](#)

26. Contribution of perinatal conditions to cerebral palsy in Uganda.

Hassell J, Tann C, Idro R, Robertson NJ.

Lancet Glob Health. 2018 Mar;6(3):e248-e249. doi: 10.1016/S2214-109X(18)30041-X.

Worldwide, an estimated 93 million children are disabled, 80% of whom live in low-income countries.¹ Cohort studies in high-income countries attribute more than 50% of cerebral palsy cases to premature birth or prenatal causes. Equivalent data have been difficult to obtain in low-resource settings, limiting the ability to lobby for better service provision for these children.

[PMID: 29433660](#)