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## Interventions and Management

### 1. Effectiveness of hand-arm bimanual intensive training on upper extremity function in children with cerebral palsy: A systematic review.

Ouyang RG, Yang CN, Qu YL, Koduri MP, Chien CW.

Eur J Paediatr Neurol. 2019 Dec 17. pii: S1090-3798(19)30437-4. doi: 10.1016/j.ejpn.2019.12.017. [Epub ahead of print]

**OBJECTIVE:** To systematically review the effectiveness of Hand-Arm Bimanual Intensive Training (HABIT) on upper limb function in children with cerebral palsy. **METHODS:** Six databases (MEDLINE, CINAHL, PubMed, Embase, Cochrane Library, and PsycINFO) were searched for HABIT-related studies published in English between 2007 and 2017. The methodological quality of the included studies was classified based on the Levels of Evidence of the American Occupational Therapy Association guidelines. If the included studies were randomized controlled trials (RCTs), the methodological quality was evaluated using the Revised Cochrane risk of bias tool. Cohen's d effect sizes were computed and synthesized to assess the effectiveness. **RESULTS:** Among 646 studies, 15 fulfilled the inclusion criteria. Eleven studies were RCTs, 64% of which were rated as having a high risk of bias; one was a quasi-RCT, one was a retrospective study, and two were longitudinal studies. Nearly half of the included studies used HABIT for 6 h a day for three consecutive weeks (totaling 90 h), and some studies used different doses/schedules or added training components to HABIT. Synthesis of the results demonstrated a significantly small effect size ( $d = 0.36$ ,  $P = 0.017$ ) for improving upper limb function immediately after the interventions, and the improvements were maintained at follow-up. Similarly, significantly moderate or large effect sizes were found for self-care function ( $d = 0.52$ ,  $P = 0.003$ ) and goal improvements ( $d = 1.78-2.28$ ,  $P < 0.001$ ). **CONCLUSION:** This review supports the effectiveness of HABIT as an intervention for improving upper limb function in children with cerebral palsy.

PMID: [31902688](#)

### 2. The Seated Postural & Reaching Control Test in Cerebral Palsy: A Validation Study.

Santamaria V, Rachwani J, Saussez G, Bleyenheuft Y, Dutkowsky J, Gordon AM, Woollacott MH.

Phys Occup Ther Pediatr. 2020 Jan 3:1-29. doi: 10.1080/01942638.2019.1705456. [Epub ahead of print]

**Aim:** Children with moderate-severe cerebral palsy (CP) show postural control deficits that affect their daily activities, like reaching. The Seated Postural and Reaching Control test (SP&R-co) was developed to address the need for clinical measures that objectively identify dimensions of postural imbalance and corresponding reaching limitations in children with CP. **Methods:** SP&R-co documentation was designed for test validity and rater training. Rater and internal consistency were examined using Cronbach's  $\alpha$ . Reference SP&R-co score sheets of children and rater's scores were used for absolute item-by-item, average inter-rater, and intra-rater reliability. Motor classification systems and performance tests were used for construct and concurrent validity. **Results:** The SP&R-co scoring showed acceptable-good consistency ( $\alpha = 0.76-0.84$ ). Interrelatedness of SP&R-co items was good-excellent ( $\alpha = 0.82-0.97$ ). The raters demonstrated fair, good, and excellent item-by-item

reliability (ICC = 0.41-0.92). Inter-rater and intra-rater reliability of SP&R-co dimensions were good-excellent (ICC = 0.68-0.86 and ICC = 0.64-0.95, respectively). Construct and concurrent validity showed moderate-excellent correlations ( $r = 0.49-0.88$ ). Conclusions: Results provide evidence that the SP&R-co is a reliable and valid test for therapists to objectively examine and quantify seated postural and reaching control in children with CP.

PMID: [31900006](#)

### **3. What is the best treatment option for cervical spinal cord injury by os odontoideum in a patient with athetoid dystonic cerebral palsy?**

Lee S, Kim DH, Choi YH.

J Spinal Cord Med. 2020 Jan 9:1-5. doi: 10.1080/10790268.2019.1706289. [Epub ahead of print]

Context: Atlantoaxial instability in an athetoid dystonic cerebral palsy patient due to os odontoideum represents a rare cause of high-level cervical spinal cord injury. There is no evidence-based treatment protocol for this injury and a number of reports have debated whether nonsurgical or surgical treatment is the best option. Findings: Here, we report the case of a 32-year-old athetoid dystonic cerebral palsy patient with os odontoideum (OO) causing compressive myelopathy on the C1-2 levels. About two weeks after atlantoaxial fusion, the patient started an intensive rehabilitation program and maintained it for four weeks. He showed neurological and functional improvement at discharge after four weeks of training. There were further improvements in function and symptoms four weeks after discharge. Conclusion: Intensive rehabilitation programs are important for the recovery and good prognosis in spinal cord injury patients. However, rehabilitation of CP patients with spinal cord injury is often neglected. We provided intensive rehabilitation therapy to a patient for a cervical spinal cord injury by OO with athetoid dystonic cerebral palsy and achieved neurological and functional recovery.

PMID: [31916917](#)

### **4. Ipsilateral Corticospinal Tract Excitability Contributes to the Severity of Mirror Movements in Unilateral Cerebral Palsy: A Case Series.**

Rich TL, Nemanich S, Chen CY, Sutter EN, Feyma T, Krach LE, Gillick BT.

Clin EEG Neurosci. 2020 Jan 8:1550059419899323. doi: 10.1177/1550059419899323. [Epub ahead of print]

Mirror movements (MM) can be a clinical manifestation of unilateral cerebral palsy (UCP) causing involuntary movements when attempting to use either hand for functional activities. Atypical development of the corticospinal tract (CST) contributes to impairments in observed motor movements and functional activities. However, little is known about the underlying neurophysiology and contribution of the CST to MM. The current case study characterizes MM in 13 children and young adults with UCP ranging in age from 7 to 19 years and includes clinical and neurophysiologic variables. Clinical profiles included MM of each hand (ie, Woods and Teuber), bimanual coordination and hand use (Assisting Hand Assessment [AHA]), and perception of performance (Canadian Occupational Performance Measure [COPM]). We measured the strength of motor-evoked potentials (MEP) elicited from single-pulse transcranial magnetic stimulation (TMS) of each hemisphere to create a ratio of hemispheric responses. Our sample included three types of CST circuitry: ipsilateral ( $n = 5$ ), bilateral ( $n = 3$ ), and contralateral ( $n = 4$ ). The MEP ratio ranged from 0 to 1.45 (median 0.11) with greater MM observed in participants with ratios greater than 0.5. We observed a positive relationship between the MEP ratio and the more-affected MM score, meaning participants with larger ipsilateral responses from contralesional stimulation (eg, the contralesional hemisphere was stimulated with TMS resulting in an ipsilateral MEP response), as compared with contralateral responses, displayed greater MM than those that did not. There was no relationship between MM and function as measured by the AHA or COPM. These findings suggest a role of the contralesional hemisphere to MM, which could serve as a therapeutic target for interventions.

PMID: [31912767](#)

### **5. Migration percentage and odds of recurrence/subsequent surgery after treatment for hip subluxation in pediatric cerebral palsy: a meta-analysis and systematic review.**

Agarwal KN, Chen C, Scher DM, Dodwell ER.

J Child Orthop. 2019 Dec 1;13(6):582-592. doi: 10.1302/1863-2548.13.190064.

**PURPOSE:** This meta-analysis aims to systematically assess and quantitatively pool the best clinical evidence for migration percentage (MP) and odds ratio (OR) for recurrence/reoperation following treatment for hip subluxation in children with cerebral palsy (CP), including Botulinum Toxin A (BNT-A), soft-tissue lengthening and osteotomies. **METHODS:** Pubmed, EMBASE and Cochrane were systematically searched from between 1 January 1953 and 11 January 2017 inclusive for studies reporting resubluxation/reoperation rates, and/or MP following treatment for hip subluxation in children with CP. The primary outcome was odds of resubluxation/reoperation. The secondary outcome was change in MP. Studies were graded for quality using the Newcastle Ottawa Scale. This meta-analysis was performed and reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. **RESULTS:** A total of 14 studies were included in analysis of odds of resubluxation/reoperation and 24 studies were included in analysis of MP. The OR for resubluxation/reoperation was lower for combined osteotomies compared with femoral (OR = 0.49; 95% confidence interval (CI) 0.25 to 0.98) and for femoral osteotomy compared to soft-tissue procedures (OR = 0.20; 95% CI 0.07 to 0.61). There was no difference in odds of recurrence/reoperation between pelvic and femoral osteotomies (OR = 2.27; 95% CI 0.37 to 13.88). Combined osteotomies provided the greatest improvement in MP, while BoNT-A showed no improvement in MP. **CONCLUSION:** Resubluxation/reoperation rates are high; management with osteotomies is preferred to soft-tissue procedures alone in preventing resubluxation/reoperation. This meta-analysis is limited by the observational nature and small sample sizes of many of the included studies, with their inherent risk of bias and lack of homogeneity of patient characteristics at baseline. It is possible that with larger and higher quality studies, the results and conclusions of this analysis may be altered.

PMID: [31908675](#)

## 6. Botulinum toxin type A for spastic cerebral palsy: Is it time to change praxis?

Colovic H, Dimitrijevic L, Stankovic I, Radovic-Janosevic D, Zlatanovic D.

J Rehabil Med. 2020 Jan 8. doi: 10.2340/16501977-2641. [Epub ahead of print]

PMID: [31922204](#)

## 7. The intra- and inter-rater reliability of the Goldsmith indices of body symmetry in non-ambulant adults with cerebral palsy.

Holmes C, Fredrickson E, Brock K, Morgan P.

Disabil Rehabil. 2020 Jan 7:1-7. doi: 10.1080/09638288.2019.1708979. [Epub ahead of print]

**Purpose:** Non-ambulant adults with cerebral palsy are at risk of developing asymmetry affecting thoracic cage, pelvis and hips. The primary aim of this study was to establish intra-rater and inter-rater reliability of the Goldsmith Indices of Body Symmetry in non-ambulant adults with cerebral palsy. The secondary aim was to establish comparative data for the Goldsmith Indices of Body Symmetry in healthy adults. **Materials and method:** Thirty non-ambulant young adults with cerebral palsy (17 males), and 48 young healthy controls (19 males), were recruited. Thoracic shape and symmetry, pelvic orientation and hip range, was measured using the Goldsmith Indices of Body Symmetry. Intra-rater reliability was established by repeated measurement within a single session. Inter-rater reliability was established having two raters measure each participant on two sequential sessions. Analysis utilised intraclass correlation coefficients. **Results:** The Goldsmith Indices of Body Symmetry has excellent intra-rater reliability (intraclass correlation coefficients  $\geq 0.97$ ). Inter-rater reliability for all Goldsmith Indices of Body Symmetry measures was good to excellent (intraclass correlation coefficients  $\geq 0.85$ ). Range and variability of results was greater for participants with cerebral palsy compared to comparative data. **Conclusion:** The Goldsmith Indices of Body Symmetry has good inter and intra-rater reliability for measurement of thoracic shape and symmetry, pelvic orientation and hip range, allowing accurate tracking of postural changes over time in non-ambulant adults with cerebral palsy. **Implications for rehabilitation** The Goldsmith Indices of Body Symmetry is a reliable clinical measurement tool to enable measurement of the thoracic shape and symmetry, pelvic and hip orientation in adults with cerebral palsy. The Goldsmith Indices of Body Symmetry, with an impairment focus, is a useful adjunct to the assessment and management of postural asymmetry in adults with cerebral palsy.

PMID: [31910698](#)

### **8. Protocol: Using Single-Case Experimental Design to Evaluate Whole-Body Dynamic Seating on Activity, Participation, and Quality of Life in Dystonic Cerebral Palsy.**

Gimeno H, Adlam T.

Healthcare (Basel). 2019 Dec 31;8(1). pii: E11. doi: 10.3390/healthcare8010011.

**Introduction:** People with hyperkinetic movement disorders, including dystonia, experience often painful, involuntary movements affecting functioning. Seating comfort is a key unmet need identified by families. This paper reports a protocol to assess the feasibility and preliminary evidence for the efficacy of dynamic seating to improve functional outcomes for young children with dystonic cerebral palsy (DCP). **Design:** A series of single-case experimental design N-of-1 trials, with replications across participants, with a random baseline interval, and one treatment period (n = 6). **Methods:** Inclusion criteria: DCP; 21.5 cm < popliteal fossa to posterior sacrum < 35 cm; Gross Motor Function Classification System level IV-V; mini-Manual Ability Classification System level IV-V; difficulties with seating. **Intervention:** Trial of the seat (8 weeks), with multiple baseline before, during and after intervention and 2 month follow up. The baseline duration will be randomised per child (2-7 weeks). **Primary outcomes:** Performance Quality Rating Scale; Canadian Occupational Performance Measure; seating tolerance. The statistician will create the randomization, with allocation concealment by registration of participants prior to sending the allocation arm to the principal investigator. Primary outcomes will be assessed from video by an assessor blind to allocation. **Analysis:** Participant outcome data will be plotted over time, with parametric and non-parametric analysis including estimated size effect for N-of-1 trials.

PMID: [31906107](#)

### **9. Efficacy and safety of core stability training on gait of children with cerebral palsy: A protocol for a systematic review and meta-analysis.**

Huang C, Chen Y, Chen G, Xie Y, Mo J, Li K, Huang R, Pan G, Cai Y, Zhou L.

Medicine (Baltimore). 2020 Jan;99(2):e18609. doi: 10.1097/MD.00000000000018609.

**BACKGROUND:** Cerebral palsy (CP) is a common disability in children featured with pathological gait and limb function limitation due to muscle weakness. Improving limb function and quality of life is currently considered to be highlighted. Physiotherapy is a chief component of rehabilitation for children with CP, correcting gait and improve walking capacity through muscle strength training. Standard rehabilitation programs for CP have not been determined. Core stability training (CST), which coordinates limb balance via trunk control, is widely used in sports competition. And it is gradually introduced into the rehabilitation of children with cerebral palsy with a positive impact on the patients' gait performance. By screening published literatures, this study aims to conduct a meta-analysis to systematically evaluate the effectiveness and safety of CST in gait of children with CP. **METHODS:** Randomized controlled trials (RCTs) and controlled clinical trials (CCTs) on CST in the treatment of children with CP were searched from 6 databases. Moreover, the reference lists of conference papers and included literatures will be manually searched to avoid omissions. Literature screening and data extraction were performed independently by 2 researchers. RCTs carry out the risk of bias analysis evaluation from seven aspects through the Cochrane Collaboration's risk of bias tool. Fixed or random effect model will be performed to analyze the outcomes. When higher heterogeneity occurs ( $I^2 > 50\%$ ), the sensitivity or subgroup analysis will also be conducted to find potential factors. And the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach is used for assessing the quality of evidence. **RESULTS:** The study will evaluate the effect of CST on gait of children with CP from multiple outcomes, including walking speed, endurance, stride length, and safety. **CONCLUSION:** Based on evidence-based medicine, the conclusion of this study can demonstrate the effectiveness and safety of CST in gait correction for children with CP. **PROSPERO REGISTRATION NUMBER:** PROSPERO CRD 42019134094.

PMID: [31914039](#)

### **10. Muscle Synergy Constraints Do Not Improve Estimates of Muscle Activity From Static Optimization During Gait for Unimpaired Children or Children With Cerebral Palsy.**

Shuman BR, Goudriaan M, Desloovere K, Schwartz MH, Steele KM.

Front Neurorobot. 2019 Dec 17;13:102. doi: 10.3389/fnbot.2019.00102. eCollection 2019.

Neuromusculoskeletal simulation provides a promising platform to inform the design of assistive devices or inform rehabilitation. For these applications, a simulation must be able to accurately represent the person of interest, such as an individual with a neurologic injury. If a simulation fails to predict how an individual recruits and coordinates their muscles during movement, it will have limited utility for informing design or rehabilitation. While inverse dynamic simulations have previously been used to evaluate anticipated responses from interventions, like orthopedic surgery or orthoses, they frequently struggle to accurately estimate muscle activations, even for tasks like walking. The simulated muscle activity often fails to represent experimentally measured muscle activity from electromyographic (EMG) recordings. Research has theorized that the nervous system may simplify the range of possible activations used during dynamic tasks, by constraining activations to weighted groups of muscles, referred to as muscle synergies. Synergies are altered after neurological injury, such as stroke or cerebral palsy (CP), and may provide a method for improving subject-specific models of neuromuscular control. The aim of this study was to test whether constraining simulation to synergies could improve estimated muscle activations compared to EMG data. We evaluated modeled muscle activations during gait for six typically developing (TD) children and six children with CP. Muscle activations were estimated with: (1) static optimization (SO), minimizing muscle activations squared, and (2) synergy SO (SynSO), minimizing synergy activations squared using the weights identified from EMG data for two to five synergies. While SynSO caused changes in estimated activations compared to SO, the correlation to EMG data was not higher in SynSO than SO for either TD or CP groups. The correlations to EMG were higher in CP than TD for both SO (CP: 0.48, TD: 0.36) and SynSO (CP: 0.46, TD: 0.26 for five synergies). Constraining activations to SynSO caused the simulated muscle stress to increase compared to SO for all individuals, causing a 157% increase with two synergies. These results suggest that constraining simulated activations in inverse dynamic simulations to subject-specific synergies alone may not improve estimation of muscle activations during gait for generic musculoskeletal models.

PMID: [31920612](#)

### **11. Change in popliteal angle and hamstrings spasticity during childhood in ambulant children with spastic bilateral cerebral palsy. A register-based cohort study.**

Fosdahl MA, Jahnsen R, Pripp AH, Holm I.

BMC Pediatr. 2020 Jan 8;20(1):11. doi: 10.1186/s12887-019-1891-y.

**BACKGROUND:** Muscle contractures are developing during childhood and may cause extensive problems in gait and every day functioning in children with cerebral palsy (CP). The aim of the present study was to evaluate how the popliteal angle (PA) and hamstrings spasticity change during childhood in walking children with spastic bilateral CP. **METHODS:** The present study was a longitudinal register-based cohort study including 419 children (1-15 years of age) with spastic bilateral CP, gross motor function classification system (GMFCS) level I, II and III included in the Norwegian CP Follow-up Program (CPOP). From 2006 to 2018 a total of 2193 tests were performed. The children were tested by trained physiotherapists yearly or every second year, depending on GMFCS level and age. The PA and the hamstrings spasticity (Modified Ashworth scale (MAS)) were measured at every time point. Both legs were included in the analysis. **RESULTS:** There was an increase in PA with age for all three GMFCS levels with significant differences between the levels from 1 up to 8 years of age. At the age of 10 years there was no significant difference between GMFCS level II and III. At the age of 14 years all three GMFCS levels had a mean PA above 40° and there were no significant differences between the groups. The hamstrings spasticity scores for all the three GMFCS levels were at the lower end of the MAS (mean < 1+), however they were significantly different from each other until 8 years of age. The spasticity increased the first four years in all three GMFCS levels, thereafter the level I and II slightly increased, and level III slightly decreased, until the age of 15 years. **CONCLUSION:** The present study showed an increasing PA during childhood. There were significantly different PAs between GMFCS level I, II and III up to 8 years of age. At the age of 14 years all levels showed a PA above 40°. The spasticity increased up to 4 years of age, but all the spasticity scores were at the lower end of the MAS during childhood

PMID: [31914961](#)

### **12. A prospective study investigating gross motor function of children with cerebral palsy and GMFCS level II after long-term Botulinum toxin type A use.**

Valentine J, Davidson SA, Bear N, Blair E, Paterson L, Ward R, Forbes D, Elliott C.

BMC Pediatr. 2020 Jan 6;20(1):7. doi: 10.1186/s12887-019-1906-8.

**BACKGROUND:** The aim of this study is to contribute to the knowledge base on the long-term outcomes of evidence-based medical interventions used to improve gross motor function in children and adolescents with Cerebral Palsy. **METHOD:** Prospective cohort study of children with Cerebral Palsy in the birth years 2000-2009 attending a tertiary level service for children with Cerebral Palsy who's first recorded Gross Motor Function Classification System level was II. **RESULTS:** A total of 40 children were eligible for the study, of whom 28 (72.7%) enrolled. The Botulinum toxin A treatment for this cohort, (median and interquartile ranges) were: total number of lower limb Botulinum toxin A injections 11 (6.7, 5.5); total dose of Botulinum Toxin A per lower limb treatment 6.95 u/kg (4.5, 11); and dose of Botulinum Toxin u/kg/muscle 2.95 (2.2, 4). For all 28 subjects there was a median of 15 (8.5 to 22) Gross Motor Function Classification System level recordings: six of the 28 children (21.4%) improved from level II to level I, the remaining 22 children remained stable at level II (78.6%). In this highly treated population, the average 66 item Gross Motor Function Measure score for the 22 children in level II was 72.55, which is consistent with the mean of 68.5 reported in the original Ontario cohort. **CONCLUSION:** This cohort study has confirmed that children with Cerebral Palsy, Gross Motor Function level II treated at a young age with repeated doses of Botulinum Toxin A within an integrated comprehensive service, maintain or improve their functional motor level at a later age.

PMID: [31906902](#)

### **13. Strength Training to Improve Performance in Athletes With Cerebral Palsy: A Systematic Review of Current Evidence.**

Fleeton JRM, Sanders RH, Fornusek C.

J Strength Cond Res. 2020 Jan 3. doi: 10.1519/JSC.0000000000003232. [Epub ahead of print]

Fleeton, JRM, Sanders, RH, and Fornusek, C. Strength training to improve performance in athletes with cerebral palsy: A systematic review of current evidence. *J Strength Cond Res* XX(X): 000-000, 2019-Persons with cerebral palsy (CP) can partake in many different forms of organized sport including elite competition at state and international levels. There is limited evidence on how CP athletes should train to enhance performance. The purposes of this article were to conduct a systematic review of the current evidence on ambulatory individuals with CP for (a) strength and functional improvement through strength training; (b) potential sports performance improvement through strength training; (c) the identification of risk and special considerations associated with strength and conditioning for this population, and; (d) the identification of future research foci to educate strength and conditioning coaches on specific program design for elite CP athletes. Seven electronic databases were searched for studies investigating resistance training interventions. The databases were also searched for training interventions or investigations into sports performance in athletes with CP competing at regional level or above. Thirty articles were included in the systematic review of strength training, and 23 articles included in the narrative review of training for sports performance. High-quality evidence indicates that resistance training can improve muscular strength in individuals with CP, with some preliminary evidence of structural and neurological adaptations. However, there is limited evidence for functional improvements. Limited research has examined the performance capacity of athletes with CP, and no training interventions have been conducted. Coaches should employ existing guidelines when designing programs while considering specific athlete limitations. Initially, the focus should be increasing athlete muscular strength before considering specific sport demands.

PMID: [31904719](#)

### **14. Longitudinal Growth in Single-Word Intelligibility among Children with Cerebral Palsy from 24 to 96 Months of Age: Effects of Speech-Language Profile Group Membership on Outcomes.**

Hustad KC, Mahr TJ, Broman AT, Rathouz PJ.

J Speech Lang Hear Res. 2020 Jan 7:1-17. doi: 10.1044/2019\_JSLHR-19-00033. [Epub ahead of print]

**Purpose** We examined whether there were differences among speech-language profile groups of children with cerebral palsy (CP) in age of crossing 25%, 50%, and 75% intelligibility thresholds; age of greatest intelligibility growth; rate of intelligibility growth; maximum attained intelligibility at 8 years; and how well intelligibility at 36 months predicts intelligibility at 96 months when group membership is accounted for. Profile groups were children with no speech motor impairment (NSMI), those with speech motor impairment and language comprehension that is typically developing (SMI-LCT), and those with speech motor impairment and language comprehension impairment (SMI-LCI). **Method** Sixty-eight children with CP were followed longitudinally between 24 and 96 months of age. A total of 564 time points were examined across children ( $M = 8.3$

time points per child, SD = 2.6). We fitted a nonlinear random effects model for longitudinal observations, allowing for differences between profile groups. We used the fitted model trajectories to generate descriptive analyses of intelligibility growth by group and to generate simulations to analyze how well 36-month intelligibility data predicted 96-month data accounting for profile groups. Results Children with CP who have NSMI have different growth and better intelligibility outcomes than those with speech motor impairment. Children with SMI-LCT tend to have better outcomes but similar intelligibility growth as children with SMI-LCI. There may be a subset of children that cut across SMI-LCI and SMI-LCT groups who have severe speech motor involvement and show limited growth in intelligibility. Conclusions Intelligibility outcomes for children with CP are affected by profile group membership. Intelligibility growth tends to be delayed in children with speech motor impairment. Intelligibility at 3 years is highly predictive of later outcomes regardless of profile group. Intervention decision making should include consideration of early intelligibility, and treatment directions should include consideration of augmentative and alternative communication.

PMID: [31910070](#)

### **15. Prevalence of Vestibular Dysfunction in Children with Neurological Disabilities: A Systematic Review.**

Ghai S, Hakim M, Dannenbaum E, Lamontagne A.

Front Neurol. 2019 Dec 17;10:1294. doi: 10.3389/fneur.2019.01294. eCollection 2019.

**Background:** In children with neurological or neurodevelopmental conditions, vestibular disorders may co-exist with the primary condition and further contribute to disability and restriction in functional independence and participation. Awareness of their existence may favor an early diagnosis and better treatment outcomes. **Objectives:** To determine the prevalence of vestibular dysfunction in children and adolescents (3-21 years old) diagnosed with either cerebral palsy (CP), traumatic brain injury (TBI), sensorineural hearing loss (SNHL), or cochlear implantations (CI). **Methods:** Four researchers systematically reviewed the literature from three databases (EMBASE, MEDLINE, CINAHL) until June 2018. **Results:** Twenty-four studies were analyzed in this systematic review. A single, high-quality study reports a prevalence of 48.4% of spastic CP children having a saccular dysfunction. Three fair-quality studies report a prevalence of 14.6-81%, 21 days post-TBI. Twelve poor-to-high quality studies demonstrate a prevalence of 18.7-96.1% in children with SNHL. A prevalence range of 3-84% in children with CI is reported by nine fair-to-high quality studies. **Conclusion:** Clinicians should be aware of the prevalence of vestibular dysfunction in these populations and implement appropriate assessments to improve treatment outcomes.

PMID: [31920918](#)

### **16. Study protocol of a randomized controlled trial of home-based computerized executive function training for children with cerebral palsy.**

García-Galant M, Blasco M, Reid L, Pannek K, Leiva D, Laporta-Hoyos O, Ballester-Plané J, Miralbell J, Caldú X, Alonso X, Toro-Tamargo E, Meléndez-Plumed M, Gimeno F, Coronas M, Soro-Camats E, Boyd R, Pueyo R.

BMC Pediatr. 2020 Jan 7;20(1):9. doi: 10.1186/s12887-019-1904-x.

**BACKGROUND:** Cerebral palsy (CP) is frequently associated with specific cognitive impairments, such as executive dysfunction which are related to participation and quality of life (QOL). The proposed study will examine whether a computerized executive function (EF) training programme could provide superior benefits for executive functioning, participation, QOL and brain plasticity, as compared to usual care. **METHODS:** A single-blind randomized controlled trial (RCT) design will be performed. Thirty children with CP aged 8 to 12 years will participate in a home-based computerized multi-modal executive training programme (12 weeks, 5 days a week, 30 min a day training, total dose = 30 h). Thirty children with CP matched by age, sex, motor and intelligence quotient (IQ) will compose the waitlist group. Cognitive, behavioural, emotional, participation and QOL measures will be obtained at three time points: before, immediately after and 9 months after completing the training. Additionally, structural and functional (resting state) magnetic resonance images (MRI) will be obtained in a subsample of 15 children from each group. Outcomes between groups will be compared following standard principles for RCTs. **DISCUSSION:** The study will test whether the cognitive training programme exerts a positive effect not only on neuropsychological and daily functioning of children with CP but also on other measures such as participation and QOL. We will also use brain MRI to test brain functional and structural changes after the intervention. If this on-line and home-based training programme proves effective, it could be a cost-effective intervention with short- and long-term effects on EF, participation or QOL in CP. **TRIAL REGISTRATION:** ClinicalTrials.gov: NCT04025749. Registered 19 July 2019. Retrospectively registered.

PMID: [31910803](#)

### **17. Clinician awareness of brain computer interfaces: a Canadian national survey.**

Letourneau S, Zewdie ET, Jadavji Z, Andersen J, Burkholder LM, Kirton A.

J Neuroeng Rehabil. 2020 Jan 6;17(1):2. doi: 10.1186/s12984-019-0624-7.

**BACKGROUND:** Individuals with severe neurological disabilities but preserved cognition, including children, are often precluded from connecting with their environments. Brain computer interfaces (BCI) are a potential solution where advancing technologies create new clinical opportunities. We evaluated clinician awareness as a modifiable barrier to progress and identified eligible populations. **METHODS:** We executed a national, population-based, cross-sectional survey of physician specialists caring for persons with severe disability. An evidence- and experience-based survey had three themes: clinician BCI knowledge, eligible populations, and potential impact. A BCI knowledge index was created and scored. Canadian adult and pediatric neurologists, physiatrists and a subset of developmental pediatricians were contacted. Secure, web-based software administered the survey via email with online data collection. **RESULTS:** Of 922 valid emails (664 neurologists, 253 physiatrists), 137 (15%) responded. One third estimated that  $\geq 10\%$  of their patients had severe neurological disability with cognitive capacity. BCI knowledge scores were low with  $> 40\%$  identifying as less than "vaguely aware" and only 15% as "somewhat familiar" or better. Knowledge did not differ across specialties. Only 6 physicians (4%) had patients using BCI. Communication and wheelchair control rated highest for potentially improving quality of life. Most (81%) felt BCI had high potential to improve quality of life. Estimates suggested that  $> 13,000$  Canadians (36 M population) might benefit from BCI technologies. **CONCLUSIONS:** Despite high potential and thousands of patients who might benefit, BCI awareness among clinicians caring for disabled persons is poor. Further, functional priorities for BCI applications may differ between medical professionals and potential BCI users, perhaps reflecting that clinicians possess a less accurate understanding of the desires and needs of potential end-users. Improving knowledge and engaging both clinicians and patients could facilitate BCI program development to improve patient outcomes.

PMID: [31907010](#)

### **18. European and Australian Cerebral Palsy Surveillance Networks Working Together for Collaborative Research.**

Sellier E, McIntyre S, Smithers-Sheedy H, Platt MJ; SCPE and ACPR Groups.

**AIMS:** This study aims to describe and compare goals and methods, characteristics of children with cerebral palsy (CP), and to compare prevalence of CP in the Surveillance of Cerebral Palsy in Europe (SCPE) and the Australian Cerebral Palsy Register (ACPR). **METHODS:** This study compares the objectives of the two networks and their working practices; key documents from both above-mentioned networks were used. Children included in the comparison of the descriptive profile and prevalence measures were born between 1993 and 2009 for Australian data and between 1980 and 2003 for SCPE. **RESULTS:** SCPE contributed 10,756 cases and ACPR 6,803. There were similar distributions of motor type, severity, and gestational age groups, except for the proportion of the lowest gestational age category (range, 20-27 weeks) which was twice higher in the ACPR (13 vs. 7%). Associated impairment proportions were also similar except for severe vision impairment which was more than twice as high in SCPE as in the ACPR (11 vs. 4%), but most likely due to a subtle difference in definitions. Prevalence rates were comparable at the same time point in the different groups of birth weight, and declined over time, except for the moderately low birth weight in ACPR. **CONCLUSION:** Two CP networks representing two continents have compared their major characteristics to facilitate the comparison across their study populations. These characteristics proved to be similar with only marginal differences. This gives additional strength to the observation in both networks that CP prevalence is decreasing which is of great importance for families and health care systems.

PMID: [31910452](#)

### **19. What predicts the proxy-reported health-related quality of life of adolescents with cerebral palsy in Bangladesh?**

Power R, Galea C, Muhit M, Heanoy E, Karim T, Badawi N, Khandaker G.

BMC Public Health. 2020 Jan 7;20(1):18. doi: 10.1186/s12889-019-8130-1.



**BACKGROUND:** The health-related quality of life (HRQoL) of adolescents with CP in low and middle-income countries is often poor, as is the case in Bangladesh. This exploratory study examined what factors predict the proxy-reported HRQoL of adolescents with CP in rural Bangladesh, a typical low- and middle-income country (LMIC). **METHODS:** Adolescents with CP (10 to 18y) were identified using the Bangladesh Cerebral Palsy Register. HRQoL was assessed using the Cerebral Palsy Quality of Life-Teens proxy-report questionnaire (CPQoL-Teens), adolescent mental health using the Strengths and Difficulty Questionnaire (SDQ) and caregiver mental health using the Depression, Anxiety and Stress Scale (DASS-21). Theoretical and statistical interests (i.e. bivariate analysis,  $p < 0.05$ ) identified potential predictors which were entered into hierarchical multiple linear regression (HMLR) models in order of clinical significance; HMLR related adolescent clinical characteristics, adolescent and caregiver mental health and proxies of socioeconomic status to CPQoL-Teens dimensions. **RESULTS:** One hundred fifty-four adolescents with CP (mean age 15y 1mo, SD 1y 8mo, female 31.2%) participated in this study. Twenty-four factors were identified to explore for relationship to adolescent proxy-reported HRQoL. Fifteen of the factors correlated to one or more CPQoL-Teens dimension; strongest correlation was between 'feelings about functioning' and motor impairment ( $r = 0.545$ ). Nine were predictive of CPQoL-Teens dimensions; adolescent sex, school attendance, severity of motor impairment, hearing and speech impairment, mother's education, primary caregiver depression and stress, and having a sanitary latrine at home resulting in score changes of between 0.79 (95% CI 0.24 to 1.35) to 35.1 (95% CI 6.03 to 64.22). **CONCLUSIONS:** Many of the factors predicting the proxy-reported HRQoL of adolescents with CP are amenable to intervention, and have the potential to improve adolescent wellbeing. Several determinants are priorities of the sustainable development goals (SDGs); these findings should inform resource prioritization to improve the wellbeing of adolescents with CP in Bangladesh and other LMICs.

PMID: [31910840](#)

## 20. Congenital anomalies in children with cerebral palsy in rural Bangladesh.

Manlongat E, Mcintyre S, Smithers-Sheedy H, Trivedi A, Muhit M, Badawi N, Khandaker G.

Dev Med Child Neurol. 2020 Jan 6. doi: 10.1111/dmcn.14456. [Epub ahead of print]

**AIM:** To determine the proportion of children with cerebral palsy (CP) who had major congenital anomalies, describe the types of disorders, and report on the children's functional outcomes. **METHOD:** Data were extracted from the Bangladesh Cerebral Palsy Register (BCPR). Descriptive analyses were conducted on children with CP and major congenital anomalies. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to measure the association between major congenital anomalies, clinical severity, and presence of comorbidities. **RESULTS:** Between January 2015 and December 2016, 726 children with CP were newly registered with the BCPR (277 females, 449 males; mean age [SD] at registration 90mo [54mo], 4mo-18y). Seventy-eight children (11%) had a major congenital anomaly. Neurological (86%) and musculoskeletal congenital anomalies (10%) were the most common. Microcephaly was the most common congenital anomaly (83%). The odds of severe functional motor limitations (OR=2.4, 95% CI=1.9-2.9), epilepsy (OR=1.6, 95% CI=1.1-2.1), visual impairment (OR=2.6, 95% CI=2.0-3.2), presence of strabismus (OR=3.9, 95% CI=3.8-4.4), hearing (OR=1.2, 95% CI=0.6-1.9), speech (OR=5.4, 95% CI=4.6-6.2), and intellectual impairments (OR=2.3, 95% CI=1.8-2.8) were higher in children with congenital anomalies compared to children without. **INTERPRETATION:** The proportion of children with major congenital anomalies in the BCPR (11%) was lower than that identified in higher-income countries. This may be because of differences in how congenital anomalies are diagnosed as well as the impact of survival bias. In Bangladesh, children with CP and major congenital anomalies are more likely to have severe functional motor limitations and associated comorbidities. **WHAT THIS PAPER ADDS:** Eleven per cent of children with cerebral palsy (CP) in Bangladesh had major congenital anomalies. Neurological and musculoskeletal congenital anomalies were the most common. Severe functional motor limitations and associated comorbidities were more common in children presenting with CP and major congenital anomalies.

PMID: [31903557](#)

## 21. Using Rasch and factor analysis to develop a Proxy-Reported health state classification (descriptive) system for Cerebral Palsy.

Bahrampour M, Downes M, Boyd RN, Scuffham PA, Byrnes J.

Disabil Rehabil. 2020 Jan 6:1-9. doi: 10.1080/09638288.2019.1709565. [Epub ahead of print]

**Purpose:** The Cerebral Palsy quality of life instrument is a well-known health-related quality of life measure for children with

Cerebral Palsy. Due to its length it is not suitable as the basis of a preference-based instrument. The aim of this study is to develop a short version of the Cerebral Palsy quality of life instrument that can subsequently be scored as a multi-attribute utility instrument through assigning preference-based values. Methods: A sample of 473 participants who have a child with Cerebral Palsy completed the Cerebral Palsy quality of life instrument(proxy-version) instrument. After deleting questions related only to the proxy, the dimensional structure was obtained using exploratory factor analysis. Extended Rasch analysis was then undertaken to test the psychometric performance of items and select the best item to represent each dimension. Expert opinion was sought to confirm the dimensions and items. Results: A six-dimension classification system was identified, in which four domains were extracted from the factor analysis. Following expert opinion, two other domains were also added, as these were considered to have significant impact on health-related quality of life in children with Cerebral Palsy. Conclusions: The combination of Factor and Rasch analysis along with consultation with patients, clinicians and experts in health-related quality-of-life instrument development, has resulted in a short version of the Cerebral Palsy quality of life instrument. IMPLICATION FOR REHABILITATION This study provides the first classification system for children with Cerebral Palsy. The Cerebral Palsy-six dimension (CP-6D) survey, which is a short version of Cerebral Palsy Quality Of Life instrument, can be timesaving when measuring quality of life in children with Cerebral Palsy. The short version (CP-6D) can be used in preference based measurement and generate quality adjusted life years for children with Cerebral Palsy.

PMID: [31906728](#)

## 22. Mercy TAPE for Calculation-Free Height Estimation in Pediatric Rehabilitation Patients.

Modrcin AC, Luce J, Abdel-Rahman SM.

PM R. 2020 Jan 6. doi: 10.1002/pmrj.12317. [Epub ahead of print]

**INTRODUCTION:** In children, height is an essential element of a pediatric assessment yet, this measure is less likely to occur in non-ambulatory children or those with unique disabilities. There is compelling support for surrogate measures; however, many of these are accompanied by limitations. **OBJECTIVE:** This study was conducted to evaluate whether the FDA-cleared Mercy TAPE could be adopted for height estimation. **DESIGN:** Development and external validation of a height-estimation method were conducted with retrospectively collected data in non-rehabilitation children. Testing of the model was performed prospectively in a pediatric rehabilitation population. **SETTING:** U.S. pediatric rehabilitation outpatient clinic. **PARTICIPANTS:** Data from 19,407 children were used to develop the model. Data from an independent cohort of 1,472 children were used for external validation and the model was tested in 195 pediatric rehabilitation patients. Of the 195 patients, 57% required no wheelchair, 18% could ambulate independently for short distances, 17% could ambulate with an assistive device, and 8% were full time wheelchair users. **INTERVENTIONS:** Not applicable **MAIN OUTCOME MEASURES:** Relative error (RE), percentage error (PE), and percent predicted within 10% and 20% of actual height. **RESULTS:** Height estimated with the modified Mercy TAPE was highly predictive of actual height in non-rehabilitation children in the U.S. [RE (mean  $\pm$  SD) : 1.1  $\pm$  5.7 cm, PE (mean  $\pm$  SD): 1.0  $\pm$  4.7%]. In rehabilitation patients, height was underestimated to a greater extent [RE (mean  $\pm$  SD): 3.0  $\pm$  7.4 cm, PE (mean  $\pm$  SD): -2.1  $\pm$  5.6%]. **CONCLUSIONS:** The Mercy TAPE offers a reasonable approximation of height in ambulatory children, though slightly underestimates height in the pediatric rehabilitation population. Consequently, this and other surrogate measures may be less suited to examining growth against a reference ambulatory population and more suited to following individual children over time. **LEVEL OF EVIDENCE:** Level IV This article is protected by copyright. All rights reserved.

PMID: [31903703](#)

## 23. Acupuncture treatment on the motor area of the scalp for motor dysfunction in children with cerebral palsy: study protocol for a multicenter randomized controlled trial.

Wang J, Shi W, Khiati D, Shi B, Shi X, Luo D, Wang Y, Deng R, Huang H, Li J, Yan W, Yang H.

Trials. 2020 Jan 6;21(1):29. doi: 10.1186/s13063-019-3986-z.

**BACKGROUND:** Scalp acupuncture has been widely used as treatment for motor dysfunction in children with cerebral palsy in China. Previous studies have failed to provide high-quality evidence to demonstrate the effectiveness of this treatment in children with cerebral palsy. No high-quality randomized controlled trials on scalp acupuncture have been published. The aim of this study is to evaluate the effectiveness of Jiao's scalp acupuncture when combined with routine rehabilitation treatment versus routine rehabilitation treatment alone for motor dysfunction in children with cerebral palsy. **METHODS/DESIGN:** This is a four-centre randomized controlled trial. One hundred cerebral palsy patients with motor dysfunction were enrolled. Patients

will be allocated in a 1:1 ratio into either an acupuncture treatment group or a control group. Cerebral palsy patients in the control group will receive conventional rehabilitation treatment, whereas patients in the acupuncture group will receive a combination of scalp acupuncture and conventional rehabilitation treatment. Thirty-six treatment sessions will be performed over a 12-week period. The Gross Motor Function Measure and the Fine Motor Function Measure Scale will be assessed as the primary outcome measures. The Paediatric Evaluation of Disability Inventory and the Cerebral Palsy Quality of Life Questionnaire for Children will be selected as secondary outcome measures. All assessments will be conducted at baseline, week 4 (treatment 12), week 8 (treatment 24), week 12 (treatment 36) and week 24 (follow-up). **DISCUSSION:** This is the first trial evaluating the efficacy and safety of scalp acupuncture as a treatment for motor dysfunction in children with cerebral palsy. The results of this trial are expected to provide relevant evidence demonstrating that scalp acupuncture can be used as an effective rehabilitation treatment method for improving motor dysfunction in children with cerebral palsy. **TRIAL REGISTRATION:** ClinicalTrials.gov, NCT03921281. Registered on 19 April 2019.

PMID: [31907027](#)

#### **24. Rasch Analysis of the Disability Acceptance Scale for Individuals with Cerebral Palsy.**

Park EY.

Front Neurol. 2019 Dec 18;10:1260. doi: 10.3389/fneur.2019.01260. eCollection 2019.

**Background:** Acceptance of disability has been considered an important factor in rehabilitation procedures. The Disability Acceptance Scale (DAS) was used in a panel survey, and it is likely that this scale will be increasingly used. This study aimed to determine the psychometric characteristics of the DAS by applying a Rasch model, an application of item response theory. **Methods:** Data were collected using the DAS with 84 individuals with cerebral palsy. The response data were analyzed for item fitness and item difficulty, rating scale fit, and reliability. **Results:** Three of the nine DAS items had low fitness. Analysis of item difficulty showed that the item difficulty needs to be modified, suggesting the need to add some items with higher difficulty and some with lower difficulty. The 5-point Likert scale used in the evaluation questionnaires was not appropriate. An analysis of the six remaining items showed high levels of subject separation reliability and separation reliability of the items. **Conclusions:** This study is significant because it identified the psychometric characteristics of the DAS through item response theory-based Rasch analysis and suggested the need to modify the item fitness and difficulty level. A modified six-item version of the DAS with a 4-point Likert scale was proposed as being more suitable.

PMID: [31920907](#)

#### **25. Neuro-Imaging Changes in Cerebral Palsy: A Cross Sectional Study.**

Kundu GK, Ahmed S, Akhter S, Islam S.

Mymensingh Med J. 2020 Jan;29(1):121-128.

Cerebral palsy (CP) is a non- progressive disorder of movement and posture due to a lesion of the developing brain. It is the commonest physical disability in childhood that affects function and development. Neuro imaging is currently recommended as a standard evaluation in children with cerebral palsy. This hospital based cross-sectional study was conducted in Paediatric Neurology out-patient department of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from July 2015 to December 2015 to see the frequency and pattern of neuro-imaging findings in children with cerebral palsy. A total of 130 cases those who were attended and diagnosed as cerebral palsy based on history, clinical examination and neuro developmental assessment included in this study. All patients were sent to radiology & imaging department of same hospital for CT scan of brain. Among total 130 cerebral palsy patients male were more affected than female (88 boys and 42 girls) with male to female ratio 2.09: 1. Their ages ranged between 6-72 months with a mean age 25.6 months. The commonest age group was 6-24 months (46.9%). Common mode of delivery was normal vaginal delivery (62.3%) & Perinatal asphyxia (PNA) occurred in 66.9% cases. The commonest type of cerebral palsy was spastic form. Among them most cases were quadriplegic type, 64 cases (53.3%). Other cases were hemiplegic 27(20.7%) diplegic 13(10.0%). Total 84.7% had documented cerebral neuroimaging abnormalities; among them, diffuse cortical atrophy (46.9%), encephalomalacic change (19.9%), malformation (6.1%), and calcification (5.3%). CT scan was normal in 15.3% cases of cerebral palsy. The commonest co morbidity was speech delay (50%). Most of the patient with CP had abnormal CT scan finding though some patient had normal CT scan. Diffuse cerebral atrophy and encephalomalacic changes constitute frequent CT neuroimaging findings and commonly found in quadriplegic type of cerebral palsy patients. Though diagnosis of cerebral palsy is essentially clinical, neuro imaging improves the understanding of the neuro-anatomical basis for function in CP. Etiology, type of CP and extent of motor impairments can

easily be identified by the neuro imaging.

PMID: [31915347](#)

## **26. Parent preferences for neurodevelopmental screening in the neonatal intensive care unit.**

Dorner RA, Boss RD, Burton VJ, Raja K, Lemmon ME.

Dev Med Child Neurol. 2020 Jan 7. doi: 10.1111/dmcn.14457. [Epub ahead of print]

**AIM:** To determine whether, and how, neonatal intensive care unit (NICU) parents want to receive early neurodevelopmental screening information about their child's future risk of cerebral palsy and other disabilities. **METHOD:** This was a qualitative interview study. Parents of hospitalized infants born preterm completed semi-structured interviews. Data were analysed using a directed content analysis approach. **RESULTS:** Thematic saturation was achieved after 19 interviews. Four themes characterized parent perceptions of early neurodevelopmental screening: (1) acceptability: most parents were in favour of neurodevelopmental screening if parents could refuse; (2) disclosure of results: parents want emotional preparation for results, especially false positives; (3) emotional burden of uncertainty: parents of children in the NICU balance taking their infant's illness 'day by day' and preparing for an uncertain future. Parents expressed distress with screening that increased uncertainty about the future; and (4) disability: prior experience with disability informs parent concerns. **INTERPRETATION:** Parents interpret the risks and benefits of NICU developmental screening through the lens of prior experiences with disability. Most expressed interest in screening and emphasized a desire for autonomy, pretest counselling, and emotional preparation. **WHAT THIS PAPER ADDS:** Most parents with infants in the neonatal intensive care unit expressed interest in early screening for developmental disability. Prior experience with disability informed concerns about specific deficits. Parents emphasized a desire for autonomy, pretest counselling, and emotional preparation.

PMID: [31909496](#)

## **27. Intensity of perinatal care for extremely preterm babies and outcomes at a higher gestational age: evidence from the EPIPAGE-2 cohort study.**

Morgan AS, Khoshnood B, Diguisto C, Foix L'Helias L, Marchand-Martin L, Kaminski M, Zeitlin J, Bréart G, Goffinet F, Ancel PY.

BMC Pediatr. 2020 Jan 7;20(1):8. doi: 10.1186/s12887-019-1856-1.

**BACKGROUND:** Perinatal decision-making affects outcomes for extremely preterm babies (22-26 weeks' gestational age (GA)): more active units have improved survival without increased morbidity. We hypothesised such units may gain skills and expertise meaning babies at higher gestational ages have better outcomes than if they were born elsewhere. We examined mortality and morbidity outcomes at age two for babies born at 27-28 weeks' GA in relation to the intensity of perinatal care provided to extremely preterm babies. **METHODS:** Fetuses from the 2011 French national prospective EPIPAGE-2 cohort, alive at maternal admission to a level 3 hospital and delivered at 27-28 weeks' GA, were included. Morbidity-free survival (survival without sensorimotor (blindness, deafness or cerebral palsy) disability) and overall survival at age two were examined. Sensorimotor disability and Ages and Stages Questionnaire (ASQ) result below threshold among survivors were secondary outcomes. Perinatal care intensity level was based on birth hospital, grouped using the ratio of 24-25 weeks' GA babies admitted to neonatal intensive care to fetuses of the same gestation alive at maternal admission. Sensitivity analyses used ratios based upon antenatal steroids, Caesarean section, and newborn resuscitation. Multiple imputation was used for missing data; hierarchical logistic regression accounted for births nested within centres. **RESULTS:** 633 of 747 fetuses (84.7%) born at 27-28 weeks' GA survived to age two. There were no differences in survival or morbidity-free survival: respectively, fully adjusted odds ratios were 0.96 (95% CI: 0.54 to 1.71) and 1.09 (95% CI: 0.59 to 2.01) in medium and 1.12 (95% CI: 0.63 to 2.00) and 1.16 (95% CI: 0.62 to 2.16) in high compared to low-intensity hospitals. Among survivors, there were no differences in sensorimotor disability or ASQ below threshold. Sensitivity analyses were consistent with the main results. **CONCLUSIONS:** No difference was seen in survival or morbidity-free survival at two years of age among fetuses alive at maternal hospital admission born at 27-28 weeks' GA, or in sensorimotor disability or presence of an ASQ below threshold among survivors. There is no evidence for an impact of intensity of perinatal care for extremely preterm babies on births at a higher gestational age.

PMID: [31910799](#)

**28. Prevalence and Diagnosis of Neurological Disorders Using Different Deep Learning Techniques: A Meta-Analysis.**  
Gautam R, Sharma M.

J Med Syst. 2020 Jan 4;44(2):49. doi: 10.1007/s10916-019-1519-7.

This paper dispenses an exhaustive review on deep learning techniques used in the prognosis of eight different neuropsychiatric and neurological disorders such as stroke, alzheimer, parkinson's, epilepsy, autism, migraine, cerebral palsy, and multiple sclerosis. These diseases are critical, life-threatening and in most of the cases may lead to other precarious human disorders. Deep learning techniques are emerging soft computing technique which has been lucratively used to unravel different real-life problems such as pattern recognition (Face, Emotion, and Speech), traffic management, drug discovery, disease diagnosis, and network intrusion detection. This study confers the discipline, frameworks, and methodologies used by different deep learning techniques to diagnose different human neurological disorders. Here, one hundred and thirty-six different articles related to neurological and neuropsychiatric disorders diagnosed using different deep learning techniques are studied. The morbidity and mortality rate of major neuropsychiatric and neurological disorders has also been delineated. The performance and publication trend of different deep learning techniques employed in the investigation of these diseases has been examined and analyzed. Different performance metrics like accuracy, specificity, and sensitivity have also been examined. The research implication, challenges and the future directions related to the study have also been highlighted. Eventually, the research breaches are identified and it is witnessed that there is more scope in the diagnosis of migraine, cerebral palsy and stroke using different deep learning models. Likewise, there is a potential opportunity to use and explore the performance of Restricted Boltzmann Machine, Deep Boltzmann Machine and Deep Belief Network for diagnosis of different human neuropsychiatric and neurological disorders.

PMID: [31902041](#)

**29. The relationship between neuroimaging and motor outcome in children with cerebral palsy: A systematic review- Part B diffusion imaging and tractography.**

Mailleux L, Franki I, Emsell L, Peedima ML, Fehrenbach A, Feys H, Ortibus E.

Res Dev Disabil. 2019 Dec 31;97:103569. doi: 10.1016/j.ridd.2019.103569. [Epub ahead of print]

**BACKGROUND:** Diffusion magnetic resonance imaging (dMRI) is able to detect, localize and quantify subtle brain white matter abnormalities that may not be visible on conventional structural MRI. Over the past years, a growing number of studies have applied dMRI to investigate structure-function relationships in children with cerebral palsy (CP). **AIMS:** To provide an overview of the recent literature on dMRI and motor function in children with CP. **METHODS:** A systematic literature search was conducted in PubMed, Embase, Cochrane Central Register of Controlled trials, Cinahl and Web of Science from 2012 onwards. **RESULTS:** In total, 577 children with CP in 19 studies were included. Sixteen studies only included unilateral CP, while none included dyskinetic CP. Most studies focused on specific regions/tracts of interest (n = 17) versus two studies that investigated the whole brain. In unilateral and bilateral CP, white matter abnormalities were widespread including non-motor areas. In unilateral CP, consistent relationships were found between white matter integrity of the corticospinal tract and somatosensory pathways (e.g. thalamocortical projections, medial lemniscus) with upper limb sensorimotor function. The role of commissural and associative tracts remains poorly investigated. Also results describing structure-function relationships in bilateral CP are scarce (n = 3). **CONCLUSIONS:** This review underlines the importance of both the motor and somatosensory tracts for upper limb sensorimotor function in unilateral CP. However, the exact contribution of each tract requires further exploration. In addition, research on the relevance of non-motor pathways is warranted, as well as studies including other types of CP.

PMID: [31901671](#)

**30. Children with cerebral palsy: Family and parent demographic characteristics and family strengths in Greece and Italy.**

Tsibidaki A.

J Health Psychol. 2020 Jan 10;1359105319900276. doi: 10.1177/1359105319900276. [Epub ahead of print]

The study focuses on families raising a child with cerebral palsy to investigate family strengths and their association with family and parent demographic characteristics in Greece and Italy. Participants were 120 parents raising a biological child with cerebral palsy. Data collection used a self-report questionnaire and the Family Strengths Inventory. According to the findings, families share a high sense of family strengths, which is mainly represented in the high sense of 'pride' and 'accord'. In addition, demographic characteristics seem to be important predictors of well-being and strengthen parents and families raising a child with cerebral palsy.

PMID: [31918571](#)

**31. NFAT5 and HIF-1 $\alpha$  Coordinate to Regulate NKCC1 Expression in Hippocampal Neurons After Hypoxia-Ischemia.**  
Yang XL, Zeng ML, Shao L, Jiang GT, Cheng JJ, Chen TX, Han S, Yin J, Liu WH, He XH, Peng BW.

Front Cell Dev Biol. 2019 Dec 13;7:339. doi: 10.3389/fcell.2019.00339. eCollection 2019.

Hypoxic-ischemic encephalopathy (HIE) is a serious birth complication with severe long-term sequelae such as cerebral palsy, epilepsy and cognitive disabilities. Na<sup>+</sup>-K<sup>+</sup>-2Cl<sup>-</sup> cotransporters 1 (NKCC1) is dramatically upregulated after hypoxia-ischemia (HI), which aggravates brain edema and brain damage. Clinically, an NKCC1-specific inhibitor, bumetanide, is used to treat diseases related to aberrant NKCC1 expression, but the underlying mechanism of aberrant NKCC1 expression has rarely been studied in HIE. In this study, the cooperative effect of hypoxia-inducible factor-1 $\alpha$  (HIF-1 $\alpha$ ) and nuclear factor of activated T cells 5 (NFAT5) on NKCC1 expression was explored in hippocampal neurons under hypoxic conditions. HI increased HIF-1 $\alpha$  nuclear localization and transcriptional activity, and pharmacological inhibition of the HIF-1 $\alpha$  transcription activity or mutation of hypoxia responsive element (HRE) motifs recovered the hypoxia-induced aberrant expression and promoter activity of NKCC1. In contrast, oxygen-glucose deprivation (OGD)-induced downregulation of NFAT5 expression was reversed by treating with hypertonic saline, which ameliorated aberrant NKCC1 expression. More importantly, knocking down NFAT5 or mutation of the tonicity enhancer element (TonE) stimulated NKCC1 expression and promoter activity under normal physiological conditions. The positive regulation of NKCC1 by HIF-1 $\alpha$  and the negative regulation of NKCC1 by NFAT5 may serve to maintain NKCC1 expression levels, which may shed light on the transcription regulation of NKCC1 in hippocampal neurons after hypoxia.

PMID: [31921851](#)

**32. Is cerebral palsy a cause of death?**  
Ryan JM, Ryan N, Peterson MD.

Dev Med Child Neurol. 2020 Jan 6. doi: 10.1111/dmcn.14440. [Epub ahead of print]

PMID: [31904112](#)

## Prevention and Cure

**33. Cerebral palsy and obstetric-neonatal interventions.**

Młodawski J, Młodawska M, Pazera G, Michalski W, Domanski T, Dolecka-Slusarczyk M, Gluszek S, Rokita W.

Ginekol Pol. 2019;90(12):722-727. doi: 10.5603/GP.2019.0124.

Cerebral palsy is a disease that puts a great mental burden on caregivers and generates very high social costs. Children with CP require many years of rehabilitation and medical care. The etiology of the disease is undoubtedly multifactorial, and the pathogenesis is associated with focal damage to the central nervous system. One can find descriptions of well-documented interventions in the literature that reduce the risk of CP in certain groups of pregnant and neonatal patients, and interventions

that have a potentially protective effect. In this review, we have analyzed the available literature in terms of prenatal and postnatal interventions that may have an impact on reducing the incidence of this condition in children.

PMID: [31909467](#)

#### **34. The expression of Th9 and Th22 cells in rats with cerebral palsy after hUC-MSC transplantation.**

Niu X, Xu X, Luo Z, Wu, Tang J.

J Chin Med Assoc. 2020 Jan;83(1):60-66. doi: 10.1097/JCMA.000000000000202.

**BACKGROUND:** This study aimed to investigate the expression of Th9 and Th22 cells in rats with cerebral palsy (CP) after human umbilical cord-derived mesenchymal stem cell (hUC-MSC) transplantation. **METHODS:** First, hUC-MSCs were isolated from fresh umbilical cords and identified. Rats were divided into the normal group, CP group, and hUC-MSC transplantation group. The Morris water maze and balance beam tests were performed to evaluate the neurobehavioral ability of the rats. The levels of TNF- $\alpha$ , IL-6, IL-9, and IL-22 in rat brain tissues were detected by ELISA. Th9 and Th22 proportions in brain tissues were detected by flow cytometric analysis. The mRNA levels of IL-9, IL-22, PU.1, and AHR in brain tissues were determined by qRT-PCR. **RESULTS:** hUC-MSC transplantation enhanced the neurobehavioral ability of CP rats. Furthermore, Th9 and Th22 proportions were decreased in brain tissues from CP rats after hUC-MSC transplantation. The levels of proinflammatory cytokines (TNF- $\alpha$  and IL-6), Th9-related IL-9 and PU.1, and Th22-related IL-22 and AHR were markedly higher in brain tissues from CP rats than in brain tissues from control rats, but their levels were significantly decreased after hUC-MSC transplantation. **CONCLUSION:** Our data indicate that Th9 and Th22 proportions are decreased in CP rats after hUC-MSC transplantation.

PMID: [31904741](#)