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Interventions and Management

1. Development and Validation of the Both Hands Assessment for Children With Bilateral Cerebral Palsy.

Elvrum AG, Zethraeus BM, Vik T, Krumlinde-Sundholm L.

Phys Occup Ther Pediatr. 2017 May 3:1-14. doi: 10.1080/01942638.2017.1318431. [Epub ahead of print]

AIMS: To develop a hand function test for children with bilateral cerebral palsy (CP) measuring bimanual performance, including quantification of possible asymmetry of hand use. **METHOD:** The Both Hands Assessment (BoHA) content was developed through adaptation of the Assisting Hand Assessment (version 5.0). Data from 171 children with bilateral CP, 22-months to 13 years olds (75 females; mean age: 6 years and 6 months) classified at Manual Ability Classification System (MACS) levels I-III, was entered into Rasch measurement model analyses to evaluate internal scale validity and aspects of reliability. **RESULTS:** Sixteen items (11 unimanual and 5 bimanual) exhibited evidence for good internal scale validity and item and person reliability when analyzed separately for children with asymmetric or symmetric hand use. By calibrating the BoHA logit measures into the same frame of reference through linking, the overall measure of bimanual performance is comparable between children with asymmetric or symmetric hand use, still allowing use of separate item difficulty hierarchies. **CONCLUSIONS:** The Both Hands Assessment (BoHA), showed strong evidence of internal construct validity for measuring effectiveness of bimanual performance and the extent of asymmetric hand use in children with bilateral cerebral palsy, MACS levels I-III.

[PMID: 28467140](#)

2. Forearm Flexor Muscles in Children with Cerebral Palsy Are Weak, Thin and Stiff.

von Walden F, Jalaaliddini K, Evertsson B, Friberg J, Valero-Cuevas FJ, Pontén E.

Front Comput Neurosci. 2017 Apr 25;11:30. doi: 10.3389/fncom.2017.00030. eCollection 2017.

Children with cerebral palsy (CP) often develop reduced passive range of motion with age. The determining factor underlying this process is believed to be progressive development of contracture in skeletal muscle that likely changes the biomechanics of the joints. Consequently, to identify the underlying mechanisms, we modeled the mechanical characteristics of the forearm flexors acting across the wrist joint. We investigated skeletal muscle strength (Grippit®) and passive stiffness and viscosity of the forearm flexors in 15 typically developing (TD) children (10 boys/5 girls, mean age 12 years, range 8-18 yrs) and nine children with CP (nine children (6 boys/3 girls, mean age 11 ± 3 years (yrs), range 7-15 yrs) using the NeuroFlexor® apparatus. The muscle stiffness we estimate and report is the instantaneous mechanical response of the tissue that is independent of reflex activity. Furthermore, we assessed cross-sectional area of the flexor carpi radialis (FCR) muscle using ultrasound. Age and body weight did not differ significantly between the two groups. Children with CP had a significantly weaker (-65%, $p < 0.01$) grip and had smaller cross-sectional area (-43%, $p < 0.01$) of the FCR muscle. Passive stiffness of the

forearm muscles in children with CP was increased 2-fold ($p < 0.05$) whereas viscosity did not differ significantly between CP and TD children. FCR cross-sectional area correlated to age ($R^2 = 0.58$, $p < 0.01$), body weight ($R^2 = 0.92$, $p < 0.0001$) and grip strength ($R^2 = 0.82$, $p < 0.0001$) in TD children but only to grip strength ($R^2 = 0.60$, $p < 0.05$) in children with CP. We conclude that children with CP have weaker, thinner, and stiffer forearm flexors as compared to typically developing children.

[PMID: 28487645](#)

3. [Myths and evidence on the use of botulinum toxin: spasticity in adults and in children with cerebral palsy].

[Article in Spanish; Abstract available in Spanish from the publisher]

Martinez-Castrillo JC, Pena-Segura JL, Sanz-Cartagena P, Alonso-Curco X, Arbelo-Gonzalez JM, Arriola-Pereda G, Coll-Bosch MD, Conejero-Casares JA, Garcia-Ribes A, Jauma-Classen S, Pagonabarraga J, Vidal-Valls J, Garcia-Ruiz PJ.

Rev Neurol. 2017 May 16;64(10):459-470.

INTRODUCTION: Spasticity is a medical problem with a high incidence that significantly impact on the quality of life of patients and their families. **AIM:** To analyze and to answer different questions about the use of botulinum toxin type A (BTA) in our clinical practice. **DEVELOPMENT:** A group of experts in neurology develop a list of topics related with the use of BTA. Two big groups were considered: spasticity in adults and in children with cerebral palsy. A literature search at PubMed for English, French, and Spanish language articles published up to June 2016 was performed. The manuscript was structured as a questionnaire that includes those questions that, according to the panel opinion, could generate more controversy or doubt. The initial draft was reviewed by the expert panel members to allow for modifications, and after subsequent revisions for achieving the highest degree of consensus, the final text was then validated. Different questions about diverse aspects of spasticity in adults, such as methods for evaluating spasticity, infiltration techniques, doses, number of infiltration points, etc. Regarding spasticity in children with cerebral palsy, the document included questions about minimum age of infiltration, methods of analgesia, etc. **CONCLUSIONS:** This review is a tool for continuous training for neurologist and rehabilitation specialist and residents of both specialties, about different specific areas of the management of BTA.

[PMID: 28497442](#)

4. Measuring trunk control in cerebral palsy: what's next?

Saavedra S.

Dev Med Child Neurol. 2017 May 2. doi: 10.1111/dmcn.13450. [Epub ahead of print]

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

[PMID: 28464231](#)

5. The influence of the use of ankle-foot orthoses on thorax, spine, and pelvis kinematics during walking in children with cerebral palsy.

Swinnen E, Baeyens JP, Van Mulders B, Verspecht J, Degelaen M.

Prosthet Orthot Int. 2017 May 1:309364617706750. doi: 10.1177/0309364617706750. [Epub ahead of print]

BACKGROUND: To improve gait function in children with cerebral palsy, ankle-foot orthoses are often prescribed. However, until now, little attention has been devoted to the effect of ankle-foot orthoses on the postural control during walking in children with cerebral palsy. **OBJECTIVES:** The aim was to compare the differences in thorax, spine, and pelvis movements in children with cerebral palsy during walking barefoot and walking with ankle-foot orthoses. **STUDY DESIGN:** Clinical study with an intra subject design. **METHODS:** A total of 15 children (12 boys and 3 girls; mean age, 8 ± 2 years) with bilateral spastic cerebral palsy (12 with Gross Motor Function Classification System I and 3 with Gross Motor Function Classification System II) performed a full-body three-dimensional gait analysis. Differences in the range of motion of the thorax, spine, and

pelvis during walking barefoot and walking with bilateral ankle-foot orthoses were analyzed (SPSS v20, paired-samples t-test). RESULTS: Children with cerebral palsy showed a significantly larger range of motion of the thorax (flexion/extension, lateral bending, and rotation) and the spine (lateral bending) during walking with ankle-foot orthoses compared to walking barefoot. No significant differences were found in the range of motion of the pelvis between these two conditions. CONCLUSION: It can be concluded that wearing ankle-foot orthoses influences the postural control during walking in children with bilateral spastic cerebral palsy. Due to the increased range of motions, the movement pattern of the trunk diverges from the typically developing children. Clinical relevance Wearing ankle-foot orthoses not only gives more stability at the pelvis and ankle joint but also influences trunk motion. In order of the level of core stability of the child, compensations can be either seen in the lower back or the upper trunk. Clinicians should be aware of these compensations and should evaluate postural control in a more detailed evaluation.

[PMID: 28486863](#)

6. Dynamical structure of center-of-pressure trajectories with and without functional taping in children with cerebral palsy level I and II of GMFCS.

Pavão SL, Ledebt A, Savelsbergh GJP, Rocha NACF.

Hum Mov Sci. 2017 May 6;54:137-143. doi: 10.1016/j.humov.2017.04.014. [Epub ahead of print]

Postural control during quiet standing was examined in typical children (TD) and children with cerebral palsy (CP) level I and II of GMFCS. The immediate effect on postural control of functional taping on the thighs was analyzed. We evaluated 43 TD, 17 CP children level I, and 10 CP children level II. Participants were evaluated in two conditions (with and without taping). The trajectories of the center of pressure (COP) were analyzed by means of conventional posturography (sway amplitude, sway-path-length) and dynamic posturography (degree of twisting-and-turning, sway regularity). Both CP groups showed larger sway amplitude than the TD while only the CP level II showed more regular COP trajectories with less twisting-and-turning. Functional taping didn't affect sway amplitude or sway-path-length. TD children exhibited more twisting-and-turning with functional taping, whereas no effects on postural sway dynamics were observed in CP children. Functional taping doesn't result in immediate changes in quiet stance in CP children, whereas in TD it resulted in faster sway corrections. Children level II invest more attention in postural control than level I, and TD. While quiet standing was more automatized in children level I than in level II, both CP groups showed a less stable balance than TD.

[PMID: 28486165](#)

7. Reliability of center of pressure measures for assessing the development of sitting postural control through the stages of sitting.

Wickstrom J, Stergiou N, Kyvelidou A.

Gait Posture. 2017 Apr 27;56:8-13. doi: 10.1016/j.gaitpost.2017.04.031. [Epub ahead of print]

Cerebral palsy (CP) impairs an individual's ability to move and control one's posture. Unfortunately, the signs and symptoms of CP may not be apparent before age two. Evaluating sitting posture is a potential way to assess the developing mechanisms that contribute to CP. The purpose of this project was to determine the reliability of linear and nonlinear measures, including inter- and intrastage reliability, when used to analyze the center of pressure (COP) time series during the stages of sitting development in children with typical development (TD) and with/at-risk for cerebral palsy (CP). We hypothesized that nonlinear tools would be more reliable than linear tools in assessing children's sitting development, and reliability would increase with development. COP data was recorded for three trials at eight sessions. Linear parameters used were root mean square, range of sway for the anterior-posterior (AP) and medial-lateral (ML) directions, and sway path. Nonlinear parameters used were Approximate Entropy, the largest Lyapunov Exponent, and Correlation Dimension for the AP and ML direction. Participants consisted of 33 children with TD and 26 children with/at-risk for CP. Our results determined that COP is a moderately reliable method for assessing the development of sitting postural control in stages in both groups. Thus, clinicians may be able to use measures from COP data across stages to assess the efficacy of therapeutic interventions that are intended to improve sitting postural abilities in children with/at-risk for CP.

[PMID: 28477560](#)

8. Recurrence of Deep Surgical Site Infection in Cerebral Palsy After Spinal Fusion Is Rare.

Jain A, Modhia UM, Njoku DB, Shah SA, Newton PO, Marks MC, Bastrom TP, Miyanji F, Sponseller PD.

Spine Deform. 2017 May;5(3):208-212. doi: 10.1016/j.jspd.2016.12.004.

STUDY DESIGN: Retrospective review of prospective registry. **OBJECTIVES:** To assess the following in children with cerebral palsy (CP) who develop deep surgical site infection (DSSI) after spinal fusion: (1) rate of infection recurrence after treatment; (2) treatments used; (3) radiographic outcomes; and (4) differences in Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) scores versus those of children with no infection (NI). **SUMMARY OF BACKGROUND DATA:** Studies show high rates of surgical site infection in patients with CP but do not address late recurrence or quality-of-life effects. **METHODS:** One hundred fifty-one children with CP underwent spinal fusion surgery from 2008 through 2011 and had ≥ 2 -year follow-up. Patients who developed DSSI were compared with patients with NI. Student t tests were used to analyze deformity; analysis of variance was used to analyze CPOCHILD scores in both groups preoperatively and at final follow-up. **RESULTS:** Eleven patients developed DSSI. Causative organisms were polymicrobial infection (5 cases), *Escherichia coli* (2 cases), and *Proteus mirabilis*, *Staphylococcus aureus*, *Enterococcus faecalis*, and *Peptostreptococcus* (1 case each). All patients underwent irrigation and debridement and received at least 6 weeks of antibiotics. Six had negative-pressure-dressing-assisted wound closure; 5 had primary closure. At mean 4-year follow-up (range, 3-5 years) no patient had recurrent infection. From immediate postoperative to final follow-up, no patient had significant loss of coronal curve ($p = .77$) or pelvic obliquity ($p = .71$) correction. However, at final follow-up, comfort and emotions, overall quality-of-life, and total CPOCHILD scores in the DSSI group were significantly lower compared with the NI group ($p = .005$, $.022$, and $.026$, respectively). **CONCLUSIONS:** In children with CP who developed DSSI after spinal fusion, there was no recurrence of infection or deformity after infection treatment. CPOCHILD scores in patients with DSSI were lower compared with the NI group.

[PMID: 28449964](#)

9. Curve flexibility in cerebral palsy-related neuromuscular scoliosis: does the intraoperative prone radiograph reveal more flexibility than preoperative radiographs?

Chaudry Z, Anderson JT

Scoliosis Spinal Disord. 2017 May 4;12:15. doi: 10.1186/s13013-017-0122-2. eCollection 2017.

BACKGROUND: Spinal flexibility is determined preoperatively by manipulating the spine and assessing, radiographically, to what extent the amount of deformity reduces. Quantifying spinal flexibility is important when determining the approach to the planned operation in order to achieve the most optimal spinal correction and balance. Currently, supine traction radiography is a popular method used in patients with severe, cerebral palsy-related neuromuscular scoliosis. The different methods for determining spinal flexibility have been studied extensively in the adolescent idiopathic scoliosis population. No such studies exist in the cerebral palsy population. The purpose of this study was to determine how predictive the intraoperative prone radiograph is in determining spinal flexibility in patients with severe, cerebral palsy related neuromuscular scoliosis. Furthermore, the intraoperative prone radiograph was compared to the preoperatively acquired supine and supine traction radiographs. **METHODS:** Twenty-five consecutive patients with severe, cerebral palsy-related neuromuscular scoliosis were studied. The Cobb angles of the preoperative supine, preoperative supine traction, and intraoperative prone radiograph were measured and compared. The flexibility indices of these radiographs were calculated and compared. Traction was not applied during acquisition of the intraoperative prone radiograph. The radiograph was taken during the exposure to localize surgical levels, prior to instrumentation. **RESULTS:** The supine traction radiograph and the intraoperative prone radiograph had higher flexibility indices than the preoperative supine radiograph. These comparisons were statistically significant. The comparison between the flexibility indices of the supine traction radiograph and intraoperative prone radiograph was not statistically significant. When looking at the preoperative supine traction radiograph separately, it was noted that the process of instrumentation led to 30% more correction of the Cobb angle. **CONCLUSIONS:** The intraoperative prone radiograph is more predictive of spinal flexibility in patients with severe scoliosis related to cerebral palsy when compared to the preoperative supine radiograph but not the preoperative supine traction radiograph. The preoperative supine traction radiograph serves as the optimal method for determining spinal flexibility in patients with severe, cerebral palsy-related neuromuscular scoliosis.

[PMID: 28474006](#)

10. An Acceleration-Based Gait Assessment Method for Children with Cerebral Palsy.

Chen X, Liao S, Cao S, Wu, Zhang X.

Sensors (Basel). 2017 May 2;17(5). pii: E1002. doi: 10.3390/s17051002.

With the aim of providing an objective tool for motion disability assessment in clinical diagnosis and rehabilitation therapy of cerebral palsy (CP) patients, an acceleration-based gait assessment method was proposed in this paper. To capture gait information, three inertial measurement units (IMUs) were placed on the lower trunk and thigh, respectively. By comparing differences in the gait acceleration modes between children with CP and healthy subjects, an assessment method based on grey relational analysis and five gait parameters, including Pearson coefficient, variance ratio, the number of extreme points, harmonic ratio and symmetry was established. Twenty-two children with cerebral palsy (7.49 ± 2.86 years old), fourteen healthy adults (24.2 ± 1.55 years old) and ten healthy children (7.03 ± 1.49 years old) participated in the gait data acquisition experiment. The results demonstrated that, compared to healthy subjects, the symptoms and severity of motor dysfunction of CP children could result in abnormality of the gait acceleration modes, and the proposed assessment method was able to effectively evaluate the degree gait abnormality in CP children.

[PMID: 28468319](#)

11. Comparative analysis of the beneficial effects of treadmill training and electroacupuncture in a rat model of neonatal hypoxia-ischemia.

Kim HN, Pak ME, Shin MJ, Kim SY, Shin YB, Yun YJ, Shin HK, Choi BT.

Int J Mol Med. 2017 Jun;39(6):1393-1402. doi: 10.3892/ijmm.2017.2970. Epub 2017 Apr 27.

In the present study, we investigated whether treadmill training and electroacupuncture (EA) have autonomous or synergistic beneficial effects on deficits caused by neonatal hypoxia-ischemia in Sprague-Dawley rats. For this purpose, rats subjected to hypoxia-ischemia underwent treadmill training and EA stimulation from 4 to 8 weeks of age. Conventional EA (CEA) and scalp EA (SEA) were delivered by electrical stimulation (2 Hz, 1 mA) at traditional acupoints and at the scalp to the primary motor area, respectively. In the behavioral examination, markedly improved performances in the rotarod test were observed in the rats that underwent treadmill exercise, and in the rats that underwent treadmill exercise and CEA compared to the untreated rats subjected to hypoxia-ischemia. An improvement was also observed in the passive avoidance test in the rats that underwent treadmill training and EA. As shown by western blot analysis, the expression levels of neuronal nuclei (NeuN), 2',3'-cyclic-nucleotide 3'-phosphodiesterase and myelin basic protein (MBP) exhibited a significant decrease in the contralateral subventricular zone (SVZ) of the rats subjected to hypoxia-ischemia compared to the controls; however, these expression levels increased following treadmill exercise and EA stimulation. As shown by immunohistochemical analyses, the thickness of the corpus callosum and the integrated optical density (IOD) of MBP were significantly increased in the rats subjected to treadmill exercise and EA compared to the untreated rats subjected to hypoxia-ischemia. The synergistic effects of treadmill training and EA were also observed in the protein levels and IOD of MBP. A marked increase in the number of bromodeoxyuridine (BrdU)- and BrdU/NeuN-positive cells in the contralateral SVZ was also observed in the rats that underwent treadmill training and EA; the number of BrdU-positive cells was synergistically affected by treadmill training and EA. These results suggest that treadmill training and EA stimulation contribute to the enhancement of behavioral recovery following hypoxia-ischemia via the upregulation of myelin components and neurogenesis. Thus, treatment with EA stimulation, as well as treadmill training offers another treatment option to promote functional recovery in cerebral palsy.

[PMID: 28487967](#)

12. Comparative Efficacy of Progressive Resistance Exercise and Biomechanical Ankle Platform System on Functional Indices of Children with Cerebral Palsy.

Adepoju F, Hamzat T, Akinyinka O.

Ethiop J Health Sci. 2017 Jan;27(1):11-16.

BACKGROUND: Progressive Resistance Exercise (PRE) and Biomechanical Ankle Platform System (BAPS) are two of the protocols available in managing children with Cerebral Palsy (CP). The comparative effects of these modalities on selected functional indices of ambulatory type CP were the focus of this study. **METHODS:** Twenty-eight children with hemiplegic or diplegic CP receiving care at a tertiary health facility in Ibadan were consecutively recruited. They were systematically

assigned into two intervention groups. Namely PRE, BAPS. Both groups received intervention twice weekly for 16 weeks. At baseline, 8 and 16 weeks of intervention balance and functional mobility were assessed using Berg Balance Scale (BBS) and modified timed-up-and-go test (TUG) respectively. Chi-square, Fisher's Exact tests, One way and repeated measures ANOVA were carried out. Level of significance (p) was set at 0.05. RESULTS: There were significant differences in the functional indices of participants in the BAPS group at the end of the intervention ($p < 0.05$). The two groups (BAPS and PRE) were not significantly different at baseline and 8 and 16 weeks ($p > 0.05$). All outcome measures increased in both groups from baseline to the end of the intervention period. CONCLUSION: The two intervention protocols demonstrated improvements in the areas assessed. Comparatively, both PRE and BAPS could be used to promote function in CP.

[PMID: 28458486](#)

13. Limits of Calcaneal Lengthening for Treating Planovalgus Foot Deformity in Children With Cerebral Palsy.

Luo CA, Kao HK, Lee WC, Yang WE, Chang CH.

Foot Ankle Int. 2017 May 1:1071100717702596. doi: 10.1177/1071100717702596. [Epub ahead of print]

BACKGROUND: Calcaneal lengthening is used to correct symptomatic planovalgus foot deformity, but outcomes have been less satisfactory in children with cerebral palsy. This study aimed to define limits of calcaneal lengthening by analyzing the risk factors for undercorrection of deformity. METHODS: We retrospectively reviewed 20 cases of children with cerebral palsy who underwent calcaneal lengthening of 30 planovalgus feet at a mean age of 11.9 years. Foot deformities were evaluated by the anteroposterior talo-first metatarsal angle (normal, 10 ± 7.0 degrees), lateral talo-first metatarsal angle (normal, 13 ± 7.5 degrees), and lateral calcaneal pitch angle (normal, 17 ± 6.0 degrees) on standing foot radiographs. Among these parameters, a corrected foot was defined as 2 or 3 parameters being corrected to within a normal range, and an undercorrected foot was only 1 or no parameter being corrected to within a normal range. Factors were compared between the corrected group and undercorrected group for significant predictors, and cutoff values of predictors were calculated for use as a clinical guideline. RESULTS: Seventeen planovalgus feet were corrected satisfactorily by calcaneal lengthening, while the other 13 feet were undercorrected. Undercorrected feet had a greater preoperative anteroposterior talonavicular angle (33.7 vs 22.8 degrees, $P = .001$) and a smaller lateral calcaneal pitch (-1.7 vs 5.6 degrees, $P = .03$). A talonavicular angle of more than 24 degrees and calcaneal pitch less than -5 degrees were identified as cutoff values using a receiver operating characteristic curve. The predicted probability of undercorrection was 100% (9/9 feet) for 2 positive predictors, 50% (8/16 feet) for 1 positive predictor, and 0 (0/5 feet) for zero predictors. CONCLUSION: A talonavicular lateral subluxation of more than 24 degrees on the anteroposterior radiograph and a calcaneal pitch angle less than -5 degrees on the lateral radiograph were 2 independent predictors that could be used to identify a planovalgus deformity that would be beyond the corrective capacity of calcaneal lengthening to restore normal alignment. Level of Evidence Retrospective case control study, level III.

[PMID: 28474963](#)

14. Correction: The Effects of Selective Dorsal Rhizotomy on Balance and Symmetry of Gait in Children with Cerebral Palsy.

Rumberg F, Bakir MS, Taylor WR, Haberl H, Sarpong A, Sharankou I, Lebek S, Funk JF.

PLoS One. 2017 May 8;12(5):e0177585. doi: 10.1371/journal.pone.0177585. eCollection 2017.

[This corrects the article DOI: 10.1371/journal.pone.0152930].

Erratum for

The Effects of Selective Dorsal Rhizotomy on Balance and Symmetry of Gait in Children with Cerebral Palsy. [PLoS One. 2016]

[PMID: 28481936](#)

15. In vivo muscle behaviour in cerebral palsy with an equinus gait: are we on track?

Schless SH, Desloovere K, Bar-On L.

Dev Med Child Neurol. 2017 Apr 28. doi: 10.1111/dmcn.13447. [Epub ahead of print]

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

[PMID: 28452050](#)**16. Differences in body composition according to gross motor function in children with cerebral palsy.**

Sung KH, Chung CY, Lee KM, Cho BC, Moon SJ, Kim J, Park MS.

Arch Phys Med Rehabil. 2017 Apr 29. pii: S0003-9993(17)30267-8. doi: 10.1016/j.apmr.2017.04.005. [Epub ahead of print]

OBJECTIVES: To assess differences in body composition according to gross motor function in children with cerebral palsy (CP) compared to healthy controls. **DESIGN:** Retrospective case control study. **SETTING:** Tertiary referral center for CP **PARTICIPANTS:** One hundred consecutive patients (mean age, 11.5 ± 4.2 years) with CP who were admitted for orthopedic surgery between May 2014 and March 2016 and 46 typically developing children (TDC, control group) were included. **INTERVENTION:** Not applicable **MAIN OUTCOME MEASURES:** Bioelectrical impedance analysis (BIA) was used to assess body composition, including body fat, soft lean mass (SLM), fat free mass (FFM), skeletal muscle mass (SMM), body cell mass (BCM), bone mineral content (BMC), and basal metabolic rate (BMR). Body composition measures were compared according to gross motor function classification system (GMFCS) level, as well as between children with CP and TDC. **RESULTS:** Children with CP with GMFCS levels IV and V had a lower height, weight, and body mass index than those with GMFCS levels I, II, and III. Children with CP with GMFCS levels IV and V had a significantly lower SLM, SLM index, FFM, FFM index, SMM, SMM index, BCM, BCM index, BMC, and BMC index than those with GMFCS levels I to III and TDC. GMFCS level significantly affected SLM and BMC. **CONCLUSIONS:** Body composition analysis using BIA showed that non-ambulatory children with CP had significantly lower FFM, SLM, SMM, BCM, and BMC than ambulatory children with CP and TDC. However, further study is required to allow the use of BIA as a valid nutritional assessment tool in patients with CP.

[PMID: 28465219](#)**17. A systematic review of scales to measure dystonia and choreoathetosis in children with dyskinetic cerebral palsy.**

Stewart K, Harvey A, Johnston LM.

Dev Med Child Neurol. 2017 May 9. doi: 10.1111/dmcn.13452. [Epub ahead of print]

AIM: To identify and systematically review the psychometric properties and clinical utility of dystonia and choreoathetosis scales reported for children with cerebral palsy (CP). **METHOD:** Six electronic databases were searched for dystonia and choreoathetosis scales with original psychometric data for children with CP aged 0 to 18 years. **RESULTS:** Thirty-four papers met the inclusion criteria, which contained six scales purported to measure dystonia and/or choreoathetosis in children with CP: the Burke-Fahn-Marsden Dystonia Rating Scale; Barry-Albright Dystonia Scale; Unified Dystonia Rating Scale; Movement Disorder-Childhood Rating Scale; Movement Disorder-Childhood Rating Scale 0-3 Years; and the Dyskinesia Impairment Scale. **INTERPRETATION:** Each scale provides useful information about dyskinesia, with most focusing on dystonia. The Barry-Albright Dystonia Scale, which was designed for CP, is the most commonly reported scale and least complex to use clinically. The Dyskinesia Impairment Scale is the only tool to consider both dystonia and choreoathetosis in CP. All tools are designed to classify movement disorders at the level of body functions and structures, rather than activity limitations or participation restrictions, although many provide some insight into the impact of dystonia on activities. Further studies are required to fully examine the validity, reliability, responsiveness, and clinical utility of each scale specifically for children with CP.

[PMID: 28485494](#)

18. Dystonic storm: a practical clinical and video review.

Termsarasab P, Frucht SJ.

J Clin Mov Disord. 2017 Apr 28;4:10. doi: 10.1186/s40734-017-0057-z. eCollection 2017.

Dystonic storm is a frightening hyperkinetic movement disorder emergency. Marked, rapid exacerbation of dystonia requires prompt intervention and admission to the intensive care unit. Clinical features of dystonic storm include fever, tachycardia, tachypnea, hypertension, sweating and autonomic instability, often progressing to bulbar dysfunction with dysarthria, dysphagia and respiratory failure. It is critical to recognize early and differentiate dystonic storm from other hyperkinetic movement disorder emergencies. Dystonic storm usually occurs in patients with known dystonia, such as DYT1 dystonia, Wilson's disease and dystonic cerebral palsy. Triggers such as infection or medication adjustment are present in about one-third of all events. Due to the significant morbidity and mortality of this disorder, we propose a management algorithm that divides decision making into two periods: the first 24 h, and the next 2-4 weeks. During the first 24 h, supportive therapy should be initiated, and appropriate patients should be identified early as candidates for pallidal deep brain stimulation or intrathecal baclofen. Management in the next 2-4 weeks aims at symptomatic dystonia control and supportive therapies.

[PMID: 28461905](#)

19. Cerebral palsy: is the concept still viable?

Rosenbaum P.

Dev Med Child Neurol. 2017 Jun;59(6):564. doi: 10.1111/dmcn.13418.

[No abstract available].

[PMID: 28463457](#)

20. Understanding cerebral palsy: the power of population-based surveillance.

Van Naarden Braun K.

Dev Med Child Neurol. 2017 May 9. doi: 10.1111/dmcn.13462. [Epub ahead of print]

[This commentary is on the original article by Delobel-Ayoub et al.]

[PMID: 28485499](#)

21. Cerebral palsy and seizures in a child with tubulinopathy pattern dysgenesis and focal cortical dysplasia.

Sweet KM, Shaw DWW, Chapman T.

Radiol Case Rep. 2017 Jan 30;12(2):396-400. doi: 10.1016/j.radcr.2016.12.008. eCollection 2017 Jun.

A 7-year-old boy with a history of spasticity, global developmental delay, and seizures was given the general diagnosis of cerebral palsy at an early age. Chromosomal array analysis performed at an outside center was normal. The patient's family sought neurodevelopmental pediatric care at a new institution following a move out of state. Electroencephalography confirmed abnormal epileptogenic activity. Brain magnetic resonance imaging showed findings consistent with a tubulin gene defect (tubulinopathy) and of focal cortical dysplasia, as well as evidence of a remote occipital lobe injury. This case report describes the various brain magnetic resonance findings suggestive of a tubulin gene defect and raises the possibility of focal cortical dysplasia manifesting as a result of tubulin dysfunction.

[PMID: 28491196](#)

22. Language Development and Brain Magnetic Resonance Imaging Characteristics in Preschool Children With Cerebral Palsy.

Choi JY, Choi YS, Park ES.

J Speech Lang Hear Res. 2017 May 8;1-9. doi: 10.1044/2016_JSLHR-L-16-0281. [Epub ahead of print]

PURPOSE: The purpose of this study was to investigate characteristics of language development in relation to brain magnetic resonance imaging (MRI) characteristics and the other contributing factors to language development in children with cerebral palsy (CP). **METHOD:** The study included 172 children with CP who underwent brain MRI and language assessments between 3 and 7 years of age. The MRI characteristics were categorized as normal, malformation, periventricular white matter lesion (PVWL), deep gray matter lesion, focal infarct, cortical/subcortical lesion, and others. Neurodevelopmental outcomes such as ambulatory status, manual ability, cognitive function, and accompanying impairments were assessed. **RESULTS:** Both receptive and expressive language development quotients (DQs) were significantly related to PVWL or deep gray matter lesion severity. In multivariable analysis, only cognitive function was significantly related to receptive language development, whereas ambulatory status and cognitive function were significantly associated with expressive language development. More than one third of the children had a language developmental discrepancy between receptive and expressive DQs. Children with cortical/subcortical lesions were at high risk for this discrepancy. **CONCLUSIONS:** Cognitive function is a key factor for both receptive and expressive language development. In children with PVWL or deep gray matter lesion, lesion severity seems to be useful to predict language development.

[PMID: 28492849](#)

23. Dental trauma in Italian children and adolescents with special health care needs. A cross-sectional retrospective study.

Bagattoni S, Sadotti A, D'Alessandro G, Piana G.

Eur J Paediatr Dent. 2017 Mar;18(1):23-26. doi: 10.23804/ejpd.2017.18.01.05.

AIM: Dental trauma is a frequent finding in people with special health care needs. The aim of this study was to determine the prevalence of dental trauma in a sample of Italian children and adolescents with special health care needs. **MATERIALS AND METHODS:** 556 medical and dental records of children and adolescents visited from January 2010 to March 2015 were examined. Information about medical diagnosis, gender, site and type of dental trauma (DT) were collected. According to age and reflecting the dentition stage, the sample was divided into 3 groups: subjects aged 0-5 years (group A, primary dentition), 6-11 years (group B, mixed dentition), 12-18 years (group C, permanent dentition). **RESULTS:** 113 individuals experienced a DT (prevalence 20.3%), with no difference in relation to gender. Individuals with cerebral palsy and autism showed the highest frequency of DT: 39.6% and 30.4%, respectively. The highest frequency of DT occurred both in group A (21.8%) and B (21.5%), which differed significantly from group C (9%). Avulsion was the most frequent type of DT in the primary dentition (24%) and enamel-dentin fracture without pulp exposure in the permanent dentition (60%). Upper central incisors were the most affected teeth. **CONCLUSION:** The prevalence of DT in a sample of Italian children and adolescents with special health care needs is high, especially in young individuals with cerebral palsy and autism. Preventive strategies for those patients should be developed in order to reduce the risk of DT.

[PMID: 28494598](#)

24. Anthropometric Parameters of Nutritional Status in Children with Cerebral Palsy.

Melunovic M, Hadzagic-Catibusic F, Bilalovic V, Rahmanovic S, Dizdar S.

Mater Sociomed. 2017 Mar;29(1):68-72. doi: 10.5455/msm.2017.29.68-72.

INTRODUCTION: Patients with cerebral palsy (CP), besides the basic neurological damage, are also often undernourished. Adequate nutrition for children is very important during the period of intensive growth and development, which is of particular importance in patients with CP. **GOAL:** To evaluate the nutritional status of patients with CP who are treated at the Pediatric Clinic, Clinical Centre of Sarajevo University and causes of malnutrition in these patients. **MATERIALS AND METHODS:** Eighty patients with CP underwent anthropometric assessment (body weight, body height, body mass index, head circumference, subscapular skinfold thickness, triceps skinfold thickness and mid upper arm muscle circumference). Severity

of CP was classified based on the Gross Motor Function Classification System (GMFCS). We compared the anthropometric parameters of our patients with normal values of healthy children, as well as with degree of motor impairment, oromotor dysfunction, feeding assistance, length of meals and daily feeding time. RESULTS: There were significant differences in all monitored parameters in relation to normal values, with 38 (47.5%) malnourished patients in the total group, out of which 29 (63.0%) with severe motor impairment and with 9 (11.3%) obese patients in the total group. The presence of oromotor dysfunction and other monitored parameters had a significant impact on the nutritional status of these patients. CONCLUSION: In severely disabled patients with CP there is a risk of profound malnutrition. Early identification and treatment of these patients is very important for their growth, development and health.

[PMID: 28484358](#)

25. The Pediatric Version of the Eating Assessment Tool: a caregiver administered dysphagia-specific outcome instrument for children.

Serel Arslan S, Demir N, Karaduman AA, Belafsky PC.

Disabil Rehabil. 2017 May 5:1-5. doi: 10.1080/09638288.2017.1323235. [Epub ahead of print]

PURPOSE: To develop and evaluate the psychometric properties of the Pediatric version of the caregiver administered Eating Assessment Tool. METHODS: The study included developmental phase and reported content, criterion validity, internal consistency and test-retest reliability of the Pediatric Eating Assessment Tool. Literature review and the original Eating Assessment Tool were used for line-item generation. Expert consensus assessed the items for content validity over two Delphi rounds. Fifty-one healthy children to obtain normative data and 138 children with cerebral palsy to evaluate test-retest reliability, internal consistency, and criterion validity were included. The Penetration-Aspiration Scale was used to assess criterion validity. RESULTS: All items were found to be necessary. Content validity index was 0.91. The mean score of Pediatric Eating Assessment Tool for healthy children and children with cerebral palsy was 0.26 ± 1.83 and 19.5 ± 11 , respectively. The internal consistency was high with Cronbach's alpha = 0.87 for test and retest. An excellent correlation between the Pediatric Eating Assessment Tool and Penetration-Aspiration score for liquid and pudding swallowing was found ($p < 0.001$, $r = 0.77$; $p < 0.001$, $r = 0.83$, respectively). A score >4 demonstrated a sensitivity of 91.3% and specificity of 98.8% to predict penetration/aspiration. CONCLUSIONS: The Pediatric Eating Assessment Tool was shown to be a valid and reliable tool to determine penetration/aspiration risk in children. Implications for rehabilitation The pediatric eating assessment tool: a new dysphagia-specific outcome survey for children. The Pediatric Version of the Eating Assessment Tool is a dysphagia specific, parent report outcome instrument to determine penetration/aspiration risk in children. The Pediatric Version of the Eating Assessment Tool has good internal consistency, test-retest reliability and criterion-based validity. The Pediatric Version of the Eating Assessment Tool may be utilized as a clinical instrument to assess the need for further instrumental evaluation of swallowing function in children.

[PMID: 28475381](#)

26. Prevalence of Intellectual Disabilities and Epilepsy in Different Forms of Spastic Cerebral Palsy in Adults.

Vukojević M, Cvitković T, Splavski B, Ostojić Z, Šumanović-Glamuzina D, Šimić J.

Psychiatr Danub. 2017 May;29(Suppl 2):111-117.

BACKGROUND: Spastic cerebral palsy may be interconnected with other neurodevelopmental disorders such as intellectual disabilities, and epilepsy. Brain synaptic plasticity and successful restorative rehabilitation may also contribute to diminish neurological deficit of patients having cerebral palsy. The aim of this study was to investigate the prevalence of intellectual disabilities and epilepsy in adult patients with different forms of spastic cerebral palsy and to find out correlation between the severity level of intellectual disabilities and epilepsy. SUBJECTS AND METHODS: Adults diagnosed with different forms of spastic cerebral palsy were analyzed during a three-month period. The investigated features were: gender and age; form of cerebral palsy; the prevalence of intellectual disabilities and epilepsy. Intellectual disabilities were divided into 4 severity levels. The correlation between the severity level of intellectual disabilities and epilepsy was statistically analyzed. RESULTS: Intellectual disability was present in 55% of patients diagnosed with spastic cerebral palsy. Epilepsy was present in 36% of such patients. It was recorded in 51.1% of quadriplegic, 21.9% of diplegic, and 19.2% of hemiplegic patients. Intellectual disability was present in 73.8% of quadriplegic, 31.3% of diplegic, and 53.8% of hemiplegic patients. The statistically significant correlation existed between the severe intellectual disability and epilepsy. CONCLUSIONS: Intellectual disabilities and epilepsy most frequently occurred in patients with most severe forms of spastic cerebral palsy. Epilepsy is strongly

correlated to the severity level of intellectual disability. Such patients require additional special modes of treatment and restorative rehabilitation to improve the functional outcome.

[PMID: 28492217](#)

27. Association of Lead Levels and Cerebral Palsy.

Bansal N, Aggarwal A, Faridi MMA, Sharma T, Baneerjee BD.

Glob Pediatr Health. 2017 Mar 30;4:2333794X17696681. doi: 10.1177/2333794X17696681. eCollection 2017.

Background: Cerebral palsy is a common motor disability in childhood. Raised lead levels affect cognition. Children with cerebral palsy may have raised lead levels, further impairing their residual cognitive motor and behavioral abilities. **Environmental exposure and abnormal eating habits may lead to increased lead levels. Aims and Objectives:** To measure blood lead levels in children with cerebral palsy and compare them with healthy neurologically normal children. To correlate blood lead levels with environmental factors. **Material and Methods:**Design: Prospective case-control study. Setting: Tertiary care hospital. Participants: Cases comprised 34 children with cerebral palsy, and controls comprised 34 neurologically normal, age- and sex-matched children. Methods: Clinical and demographic details were recorded as per proforma. Detailed environmental history was recorded to know the source of exposure to lead. These children were investigated and treated as per protocol. Venous blood was collected in ethylenediaminetetraacetic acid vials for analysis of blood lead levels. Lead levels were estimated by Shimadzu Flame AA-6800 (atomic absorption spectrophotometer). Data were analyzed using SPSS version 17. $P < .05$ was taken as significant. **Results:** Mean blood lead levels were $9.20 \pm 8.31 \mu\text{g/dL}$ in cerebral palsy cases and $2.89 \pm 3.04 \mu\text{g/dL}$ in their controls ($P < .001$). Among children with cerebral palsy, 19 (55.88%) children had blood lead levels $\geq 5 \mu\text{g/dL}$. Lead levels in children with pica were $12.33 \pm 10.02 \mu\text{g/dL}$ in comparison to children with no history of pica, $6.70 \pm 4.60 \mu\text{g/dL}$ ($P = .029$). No correlation was found between hemoglobin and blood lead levels in cases and controls. **Conclusion:** In our study, blood lead levels are raised in children with cerebral palsy. However, further studies are required to show effects of raised levels in these children.

[PMID: 28491920](#)

28. Factors Influencing Utilization of Physiotherapy Service among Children with Cerebral Palsy in Jalandhar District of Punjab.

Sinha AG, Sharma R.

J Neurosci Rural Pract. 2017 Apr-Jun;8(2):209-215. doi: 10.4103/0976-3147.203852.

BACKGROUND: Physiotherapy plays a central role in the management of children with cerebral palsy (CP); however, literature describing the use of physiotherapy service and the factors affecting utilization of physiotherapy service for this group of children in the Indian context remain unexplored. **AIMS AND OBJECTIVES:** To describe the utilization of physiotherapy services and explore the factors affecting utilization of physiotherapy services among children with CP of Jalandhar district of Punjab. **METHODOLOGY:** During June 2009 to March 2012 interview of family members of 248 children with CP (male = 159; female = 89) was conducted using a schedule focusing on demography, constraints of resources, expectations, beliefs, awareness, and service utilization. Cross tabulation with Chi-square, univariate, and multivariate logistic regression analysis were the tools of statistical analysis. **RESULTS:** 44.4% children had not received any physiotherapy in their life time. In univariate analysis exposure to physiotherapy was found significantly associated with age of diagnosis (odds ratio [OR] = 2.47), finance constraint (OR = 2.27), personal constraint (OR = 2.54), transportation constraint (OR = 3.01), lack of advice for rehabilitation (OR = 2.36), ignorance about condition (OR = 11.94), and rehabilitation services (OR = 2.88). Multivariate model ($\chi^2 = 57.16$, $df = 15$, $P < 0.001$, pseudo R^2 Cox and Snell = 0.22, Nagelkerke = 0.27) identified two main predictor variables of nonexposure to physiotherapy-ignorance about condition (OR = 7.3) and expectation of normalcy (OR = 0.43). **CONCLUSION:** The main drivers for the use of physiotherapy among children with CP in Jalandhar district of Punjab were awareness about the condition of CP and expectation of normalcy which demonstrated a complex relationship with sociodemographic factors.

[PMID: 28479794](#)

29. Relationship between activity limitation and health-related quality of life in school-aged children with cerebral palsy: a cross-sectional study.

Park EY.

Health Qual Life Outcomes. 2017 Apr 28;15(1):87. doi: 10.1186/s12955-017-0650-8.

BACKGROUND: Information on health-related quality of life is becoming increasingly important in children with cerebral palsy. This study investigated the relationship between activity limitation and health-related quality of life in school-aged children with cerebral palsy. **METHODS:** Data were collected from 71 children aged 6-15 years with cerebral palsy. Activity limitations were assessed using functional classification systems, including the Korean-Gross Motor Function Classification System (K-GMFCS) and the Korean-Manual Ability Classification System (K-MACS). Health-related quality of life was assessed using the Korean version of the Childhood Health Assessment Questionnaire. Physical therapists collected the data by interviewing the parents of the subjects. **RESULTS:** Both the K-GMFCS and the K-MACS were significantly positively correlated with the Childhood Health Assessment Questionnaire. The Childhood Health Assessment Questionnaire score differed significantly with respect to the functional classification systems. The differences in the ratings according to the K-GMFCS levels were significant, except those between levels I and II, levels II and III, levels III and IV, and levels IV and V. In the K-MACS, there were no significant differences between levels I and II, levels III and IV, and levels IV and V. The K-GMFCS and the K-MACS were significant predictors of health-related quality of life, demonstrating 75.5% of the variance ($p < 0.05$). **CONCLUSION:** Comprehensive information on children with cerebral palsy should be gathered to provide professionals with a better understanding of health-related quality of life.

[PMID: 28454541](#)

30. Employment as a measure of participation in adults with cerebral palsy.

Michelsen SI.

Dev Med Child Neurol. 2017 Apr 28. doi: 10.1111/dmcn.13445. [Epub ahead of print]

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

[PMID: 28452046](#)

31. Predictors of parents' adherence to home exercise programs for children with developmental disabilities, regarding both exercise frequency and duration: a survey design.

Medina-Mirapeix F, Lillo-Navarro C, Montilla-Herrador J, Gacto-Sanchez M, Franco-Sierra MÁ, Escolar-Reina P.

Eur J Phys Rehabil Med. 2017 May 2. doi: 10.23736/S1973-9087.17.04464-1. [Epub ahead of print]

BACKGROUND: Many families have problems adhering to home exercise programs (HEP) for children with developmental disabilities. However, parental participation in HEP is known to have a positive effect on child-related outcome variables, as well as on parental functioning. **AIM:** This study examined whether the different behaviours of health professionals, and the behaviour and social characteristics of parents determine rates of parental adherence to both the frequency per week, and duration per session, of HEP for children with developmental disabilities attending paediatric services in early intervention centres. In this study, developmental disabilities include those caused by developmental delay or specific health conditions such as cerebral palsy, congenital illness, or others. **DESIGN:** Survey. **SETTING:** 18 early intervention centres. **POPULATION:** Parents of children with developmental disabilities receiving HEP. **METHODS:** A self-reported questionnaire was used to examine: whether frequency and duration of weekly exercise sessions was prescribed by physiotherapists; whether the child had received the HEP according to what was prescribed; and items related to the individual, social support, illnesses and the involvement of the health professional. Multiple logistic regression analyses examined their relative relevance. **RESULTS:** 219 parents participated. The rate of adherence to the prescribed frequency and duration of the HEP was similar (61.4-57.2%). The probability of adherence to both components increased for parents who had a low perception of the existence of barriers for integrating the exercises into their daily routine (OR=2.62 and 4.83). Furthermore, other cognitive factors of parents had a variable influence. The involvement of the professional had a significant impact regarding the frequency of the HEP. Professional involvement increased the probability of exercises being followed accurately by adopting strategies such as: providing information about the progress and evolution of the exercises (OR=3.75); justifying their

usefulness (OR=2.17); giving advice on how to include them into the daily routine (OR=2.54); checking skills during follow-up (OR=2.21) and asking about home adherence (OR=2.20). CONCLUSIONS: Providing information during clinical encounters, advising how to include exercises into the daily routine, and checking skills and adherence during follow-up represent practical targets for clinicians aiming to improve the frequency of HEP for children with developmental disabilities.

[PMID: 28466627](#)

32. [Factors Influencing Burnout among Mothers of Children with Cerebral Palsy].

[Article in Korean]

Seo JY, Lee HJ, You MA.

J Korean Acad Nurs. 2017 Apr;47(2):233-241. doi: 10.4040/jkan.2017.47.2.233.

PURPOSE: The purpose of this study was to examine the effects of parental stress, social support, and coping behavior on burnout among mothers caring for children with cerebral palsy. **METHODS:** Participants in this cross-sectional, descriptive study were 185 mothers who completed a self-report structured questionnaire. The data were analyzed using descriptive statistics, t-test, one-way ANOVA, correlation and multiple linear regression analyses with IBM SPSS Win 22 program. **RESULTS:** Parental stress and coping behavior were strong predictors of burnout among mothers of children with cerebral palsy. These variables explained 50.0% of the variance in burnout. Social support was not a predictor of burnout. A higher level of burnout was associated with higher levels of parental stress and lower levels of social support and coping behavior. **CONCLUSION:** Mothers of children with cerebral palsy are vulnerable to burnout. These results show that effective strategies for reducing parental stress and improving positive coping behavior are needed to reduce burnout in these mothers.

[PMID: 28470160](#)

33. Quality of life of primary caregivers of children with cerebral palsy: a comparison between mother and grandmother caregivers in Anhui province of China.

Wu J, Zhang J, Hong Y.

Child Care Health Dev. 2017 May 11. doi: 10.1111/cch.12464. [Epub ahead of print]

BACKGROUND: The aims of the study are to evaluate the quality of life of mother and grandmother primary caregivers of children with cerebral palsy (CP) and to compare the difference between these two groups of caregivers. **METHODS:** We recruited 125 mother and 52 grandmother primary caregivers of children with CP. All the primary caregivers were interviewed with the short-form 36 (SF-36) health survey version 2.0 and with researcher-designed questionnaires for family background. As for the children, social-demographic characteristics, medical history and the result of a physical examination performed by a paediatric specialist in neurological rehabilitation were also collected. **RESULTS:** Mother and grandmother caregivers scored lower than their counterparts in the general population in both summary scores. Grandmother caregivers had lower scores than mother caregivers in all eight domains and in the two summary scores, with all differences being statistically significant ($P < 0.05$), except for the domain of the mental component summary score ($P = 0.618$). The differences were found particularly remarkable in the domains of physical functioning, role physical, bodily pain and also the physical component summary score ($P < 0.001$). **CONCLUSIONS:** The quality of life is significantly unsatisfactory in both mother and grandmother primary caregivers of children with CP; this research provides evidence for the need of the monitoring of these caregivers.

[PMID: 28497475](#)

Prevention and Cure

34. Maternal Inflammation Results in Altered Tryptophan Metabolism in Rabbit Placenta and Fetal Brain.

Williams M, Zhang Z, Nance E, Drewes JL, Lesniak WG, Singh S, Chugani DC, Rangaramanujam K, Graham DR, Kannan S.

Dev Neurosci. 2017 May 11. doi: 10.1159/000471509. [Epub ahead of print]

Maternal inflammation has been linked to neurodevelopmental and neuropsychiatric disorders such as cerebral palsy, schizophrenia, and autism. We had previously shown that intrauterine inflammation resulted in a decrease in serotonin, one of the tryptophan metabolites, and a decrease in serotonin fibers in the sensory cortex of newborns in a rabbit model of cerebral palsy. In this study, we hypothesized that maternal inflammation results in alterations in tryptophan pathway enzymes and metabolites in the placenta and fetal brain. We found that intrauterine endotoxin administration at gestational day 28 (G28) resulted in a significant upregulation of indoleamine 2,3-dioxygenase (IDO) in both the placenta and fetal brain at G29 (24 h after treatment). This endotoxin-mediated IDO induction was also associated with intense microglial activation, an increase in interferon gamma expression, and increases in kynurenine and the kynurenine pathway metabolites kynurenine acid and quinolinic acid, as well as a significant decrease in 5-hydroxyindole acetic acid (a precursor of serotonin) levels in the periventricular region of the fetal brain. These results indicate that maternal inflammation shunts tryptophan metabolism away from the serotonin to the kynurenine pathway, which may lead to excitotoxic injury along with impaired development of serotonin-mediated thalamocortical fibers in the newborn brain. These findings provide new targets for prevention and treatment of maternal inflammation-induced fetal and neonatal brain injury leading to neurodevelopmental disorders such as cerebral palsy and autism.

[PMID: 28490020](#)

35. Long-Term Neuropathological Changes Associated with Cerebral Palsy in a Nonhuman Primate Model of Hypoxic-Ischemic Encephalopathy.

McAdams RM, Fleiss B, Traudt C, Schwendimann L, Snyder JM, Haynes RL, Natarajan N, Gressens P, Juul SE.

Dev Neurosci. 2017 May 10. doi: 10.1159/000470903. [Epub ahead of print]

BACKGROUND: Cerebral palsy (CP) is the most common motor disability in childhood, with a worldwide prevalence of 1.5-4/1,000 live births. Hypoxic-ischemic encephalopathy (HIE) contributes to the burden of CP, but the long-term neuropathological findings of this association remain limited. **METHODOLOGY:** Thirty-four term *Macaca nemestrina* macaques were included in this long-term neuropathological study: 9 control animals delivered by cesarean section and 25 animals with perinatal asphyxia delivered by cesarean section after 15-18 min of umbilical cord occlusion (UCO). UCO animals were randomized to saline (n = 11), therapeutic hypothermia (TH; n = 6), or TH + erythropoietin (Epo; n = 8). Epo was given on days 1, 2, 3, and 7. Animals had serial developmental assessments and underwent magnetic resonance imaging with diffusion tensor imaging at 9 months of age followed by necropsy. Histology and immunohistochemical (IHC) staining of brain and brainstem sections were performed. **RESULTS:** All UCO animals demonstrated and met the standard diagnostic criteria for human neonates with moderate-to-severe HIE. Four animals developed moderate-to-severe CP (3 UCO and 1 UCO + TH), 9 had mild CP (2 UCO, 3 UCO + TH, 3 UCO + TH + Epo, and 1 control), and 2 UCO animals died. None of the animals treated with TH + Epo died, had moderate-to-severe CP, or demonstrated signs of long-term neuropathological toxicity. Compared to animals grouped together as having no CP (no-CP; controls and mild CP only), animals with CP (moderate and severe) demonstrated decreased fractional anisotropy of multiple white-matter tracts including the corpus callosum and internal capsule, when using Tract-Based Spatial Statistics (TBSS). Animals with CP had decreased staining for cortical neurons and increased brainstem glial scarring compared to animals without CP. The cerebellar cell density of the internal granular layer and white matter was decreased in CP animals compared to that in control animals without CP. **CONCLUSIONS/SIGNIFICANCE:** In this nonhuman primate HIE model, animals treated with TH + Epo had less brain pathology noted on TBSS and IHC staining, which supports the long-term safety of TH + Epo in the setting of HIE. Animals that developed CP showed white-matter changes noted on TBSS, subtle histopathological changes in both the white and gray matter, and brainstem injury that correlated with CP severity. This HIE model may lend itself to further study of the relationship between brainstem injury and CP.

[PMID: 28486224](#)

36. Is vaginal breech delivery associated with higher risk for perinatal death and cerebral palsy compared with vaginal cephalic birth? Registry-based cohort study in Norway.

Bjellmo S, Andersen GL, Martinussen MP, Romundstad PR, Hjelle S, Moster D, Vik T.

BMJ Open. 2017 May 4;7(4):e014979. doi: 10.1136/bmjopen-2016-014979.

OBJECTIVE: This paper aims to study if vaginal breech delivery is associated with increased risk for neonatal mortality (NNM) or cerebral palsy (CP) in Norway where vaginal delivery accounts for 1/3 of all breech deliveries. **DESIGN:** Cohort study using information from the national Medical BirthRegister and Cerebral Palsy Register. **SETTING:** Births in Norway 1999-2009. **PARTICIPANTS:** 520 047 term-born singletons without congenital malformations. **MAIN OUTCOME MEASURES:** NNM, CP and a composite outcome of these and death during birth. **RESULTS:** Compared with cephalic births, breech births had substantially increased risk for NNM but not for CP. Vaginal delivery was planned for 7917 of 16 700 fetuses in breech, while 5561 actually delivered vaginally. Among these, NNM was 0.9 per 1000 compared with 0.3 per 1000 in vaginal cephalic delivery, and 0.8 per 1000 in those actually born by caesarean delivery (CD) in breech. Compared with planned cephalic delivery, planned vaginal delivery was associated with excess risk for NNM (OR 2.4; 95% CI 1.2 to 4.9), while the OR associated with planned breech CD was 1.6 (95% CI 0.7 to 3.7). These risks were attenuated when NNM was substituted by the composite outcome. Vaginal breech delivery was not associated with excess risk for CP compared with vaginal cephalic delivery. **CONCLUSION:** Vaginal breech delivery, regardless of whether planned or actual, and actual breech CD were associated with excess risk for NNM compared with vaginal cephalic delivery, but not with CP. The risk for NNM and CP in planned breech CD did not differ significantly from planned vaginal cephalic delivery. However, the absolute risk for these outcomes was low, and taking into consideration potential long-term adverse consequences of CD for the child and later deliveries, we therefore conclude that vaginal breech delivery may be recommended, provided competent obstetric care and strict criteria for selection to vaginal delivery.

[PMID: 28473516](#)

37. Characterization of a cerebral palsy-like model in rats: Analysis of gait pattern and of brain and spinal cord motor areas.

Dos Santos AS, de Almeida W, Popik B, Sbardelotto BM, Torrejais MM, de Souza MA, Centenaro LA.

Int J Dev Neurosci. 2017 May 1;60:48-55. doi: 10.1016/j.ijdevneu.2017.04.005. [Epub ahead of print]

In an attempt to propose an animal model that reproduces in rats the phenotype of cerebral palsy, this study evaluated the effects of maternal exposure to bacterial endotoxin associated with perinatal asphyxia and sensorimotor restriction on gait pattern, brain and spinal cord morphology. Two experimental groups were used: Control Group (CTG) - offspring of rats injected with saline during pregnancy and Cerebral Palsy Group (CPG) - offspring of rats injected with lipopolysaccharide during pregnancy, submitted to perinatal asphyxia and sensorimotor restriction for 30days. At 29days of age, the CPG exhibited coordination between limbs, weight-supported dorsal steps or weight-supported plantar steps with paw rotation. At 45days of age, CPG exhibited plantar stepping with the paw rotated in the balance phase. An increase in the number of glial cells in the primary somatosensory cortex and dorsal striatum were observed in the CPG, but the corpus callosum thickness and cross-sectional area of lateral ventricle were similar between studied groups. No changes were found in the number of motoneurons, glial cells and soma area of the motoneurons in the ventral horn of spinal cord. The combination of insults in the pre, peri and postnatal periods produced changes in hindlimbs gait pattern of animals similar to those observed in diplegic patients, but motor impairments were attenuated over time. Besides, the greater number of glial cells observed seems to be related to the formation of a glial scar in important sensorimotor brain areas.

[PMID: 28473192](#)