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Interventions and Management

1. Assist Technol. 2016 Apr 8. [Epub ahead of print]

Navigation of a Virtual Exercise Environment with Microsoft Kinect by People Post-stroke or with Cerebral Palsy.

Pool SM, Hoyle JM, Malone LA, Cooper L, Bickel CS, McGwin G, Rimmer JH, Eberhardt AW.

One approach to encourage and facilitate exercise is through interaction with virtual environments. The present study assessed the utility of Microsoft Kinect as an interface for choosing between multiple routes within a virtual environment through body gestures and voice commands. The approach was successfully tested on 12 individuals post-stroke and 15 individuals with CP. Participants rated their perception of difficulty in completing each gesture using a 5-point Likert scale questionnaire. The "most viable" gestures were defined as those with average success rates of 90% or higher and perception of difficulty ranging between easy to very easy. For those with CP, hand raises, hand extensions, and head nod gestures were found to be most viable. For those post-stroke, the most viable gestures were torso twists, head nods, as well as hand raises and hand extensions using the less impaired hand. Voice commands containing two syllables were viable (>85% successful) for those post-stroke; however, participants with CP were unable to complete any voice commands with a high success rate. This study demonstrated that Kinect may be useful for persons with mobility impairments to interface with virtual exercise environments, but the effectiveness of the various gestures depends upon the disability of the user.

[PMID: 27057790](#)

2. Clin Biomech (Bristol, Avon). 2016 Mar 14;34:18-21. doi: 10.1016/j.clinbiomech.2016.03.003. [Epub ahead of print]

Impact of a short walking exercise on gait kinematics in children with cerebral palsy who walk in a crouch gait.

Parent A, Raison M, Pouliot-Laforte A, Marois P, Maltais DB, Ballaz L.

BACKGROUND: Crouch gait results in an increase of the joint stress due to an excessive knee flexion. Daily walking exercises, even when performed at a self-selected speed, may result in a decrease of the extensor muscle strength which could lead to a more severe crouch gait pattern. The aim of this study was to assess the impact of a short walking exercise on gait kinematics in children with cerebral palsy who walk with a crouch gait. **METHODS:** Seven children with cerebral palsy who walk with a crouch gait were asked to walk for 6min at a self-selected speed. The spatio-temporal and kinematic measures, as well as the center of mass position were compared before and after the exercise. **FINDINGS:** There was no significant difference between walking speed before and after the walking exercise. Knee flexion and the maximal ankle dorsiflexion increased after the walking exercise. The vertical position of the center of mass decreased. No significant difference was found at the hip. **INTERPRETATION:** Children with cerebral palsy who walk with a crouch gait were more crouched after a 6-min walking exercise performed at their self-selected speed. These gait modifications could be due to fatigue of the extensor muscle groups. This study highlighted that a short walking exercise, corresponding to daily mobility, results in gait pattern modifications. Since therapies in children with cerebral palsy aim to improve motor function in everyday life situations, it could be relevant to evaluate gait adaptation after a few minutes of walking exercise.

[PMID: 27038653](#)

3. Dev Med Child Neurol. 2016 Mar 31. doi: 10.1111/dmcn.13109. [Epub ahead of print]

Effect of parent-delivered action observation therapy on upper limb function in unilateral cerebral palsy: a randomized controlled trial.

Kirkpatrick E, Pearse J, James P, Basu A.

AIM: To determine whether home-based, parent-delivered therapy comprising action observation (AO) and repeated practice (RP) improves upper limb function more than RP alone in children with unilateral cerebral palsy (UCP). **METHOD:** Design: single-blinded parallel-group randomized controlled trial with 1:1 allocation comparing AO+RP (intervention) with RP alone (control). Randomization: computer-generated, with allocation concealment by opaque sequentially-numbered envelopes. **SETTING:** northern England, August 2011 to September 2013. **PARTICIPANTS:** 70 children with UCP; mean age 5.6 years (SD 2.1), 31 female. **INTERVENTION:** home-based activities were provided, tailored to interests and abilities. **DURATION:** 15 minutes/day, 5 days/week for 3 months. **ASSESSMENTS:** Assisting Hand Assessment (AHA; primary outcome measure), Melbourne Assessment 2 (MA2), and ABILHAND-Kids at baseline, 3 months, and 6 months. **RESULTS:** Outcome data was available at 3 months for 28 children in the AO+RP group and 31 controls, and at 6 months for 26 and 28 children respectively. There were no between-group differences in AHA, MA2, or ABILHAND-Kids at 3 or 6 months versus baseline (all $p > 0.05$). Combined-group improvements ($p < 0.001$), observed in AHA and MA2 at 3 months, were maintained at 6 months. ABILHAND-Kids also showed improvement at 3 months ($p = 0.003$), maintained at 6 months. **INTERPRETATION:** Parent-delivered RP (with or without AO) improves upper limb function and could supplement therapist input.

[PMID: 27038153](#)

4. Eur Spine J. 2016 Apr 7. [Epub ahead of print]

C5 nerve palsy after posterior reconstruction surgery: predictive risk factors of the incidence and critical range of correction for kyphosis.

Kurakawa T, Miyamoto H, Kaneyama S, Sumi M, Uno K.

PURPOSE: It has been reported that the incidence of post-operative segmental nerve palsy, such as C5 palsy, is higher in posterior reconstruction surgery than in conventional laminoplasty. Correction of kyphosis may be related to such a complication. The aim of this study was to elucidate the risk factors of the incidence of post-operative C5 palsy, and the critical range of sagittal realignment in posterior instrumentation surgery. **METHODS:** Eighty-eight patients (mean age 64.0 years) were involved. The types of the disease were; 33 spondylosis with kyphosis, 27 rheumatoid arthritis, 17 athetoid cerebral palsy and 11 others. The patients were divided into two groups; Group P: patients with post-operative C5 palsy, and Group NP: patients without C5 palsy. The correction angle of kyphosis, and pre-operative diameter of C4/5 foramen on CT were evaluated between the two groups. Multivariate logistic regression analysis was used to determine the critical range of realignment and the risk factors affecting the incidence of post-operative C5 palsy. **RESULTS:** Seventeen (19.3 %) of the 88 patients developed C5 palsy. The correction angle of kyphosis in Group P (15.7°) was significantly larger than that in Group NP (4.5°). In Group P, pre-operative diameters of intervertebral foramen at C4/5 (3.2 mm) were significantly smaller than those in Group NP (4.1 mm). The multivariate analysis demonstrated that the risk factors were the correction angle and pre-operative diameter of the C4/5 intervertebral foramen. The logistic regression model showed a correction angle exceeding 20° was critical for developing the palsy when C4/5 foraminal diameter reaches 4.1 mm, and there is a higher risk when the C4/5 foraminal diameter is less than 2.7 mm regardless of any correction. **CONCLUSIONS:** This study has indicated the risk factors of post-operative C5 palsy and the critical range of realignment of the cervical spine after posterior instrumented surgery.

[PMID: 27055443](#)

5. Dev Med Child Neurol. 2016 Mar 31. doi: 10.1111/dmcn.13108. [Epub ahead of print]

Association between gross motor function and nutritional status in children with cerebral palsy: a cross-sectional study from Colombia.

Herrera-Anaya E, Angarita-Fonseca A, Herrera-Galindo VM, Martínez-Marín RD, Rodríguez-Bayona CN.

AIM: To determine the association between gross motor function and nutritional status in children with cerebral palsy (CP) residing in an urban area in a developing country. **METHOD:** We conducted a cross-sectional study in 177 children (ages 2-12y, 59.3% male) with a diagnosis of CP who were attending rehabilitation centres in Bucaramanga, Colombia (2012-2013). A

physiotherapist evaluated patients using the Gross Motor Function Classification System (GMFCS, levels I to V). Nutritional status was evaluated by nutritionists and classified according to the World Health Organization growth charts. We used linear and multinomial logistic regression methods to determine the associations. RESULTS: There were 39.5%, 6.8%, 5.6%, 16.4%, and 31.6% patients classified in levels I to V respectively. The mean adjusted differences for weight-for-age, height-for-age, BMI-for-age, and height-for-weight z-scores were significantly larger for children classified in levels II to V compared with those in level I. The children classified in levels IV and V were more likely to have malnutrition (adjusted odds ratio [OR] 5.64; 95% confidence interval [CI] 2.27-14.0) and stunting (OR 8.42; 95% CI 2.90-24.4) than those classified in GMFCS levels I to III. INTERPRETATION: Stunting and malnutrition are prevalent conditions among paediatric patients with CP, and both are directly associated with higher levels of gross motor dysfunction.

[PMID: 27038060](#)

6. Dev Neurorehabil. 2016 Apr 7:1-6. [Epub ahead of print]

A microcosting study of the surgical correction of upper extremity deformity in children with spastic cerebral palsy.

Alewijnse JV, van Rooijen EM, Kreulen M, Smeulders MJ, Tan SS.

OBJECTIVE: Determine healthcare costs of upper-extremity surgical correction in children with spastic cerebral palsy (CP). METHOD: This cohort study included 39 children with spastic CP who had surgery for their upper extremity at a Dutch hospital. A retrospective cost analysis was performed including both hospital and rehabilitation costs. Hospital costs were determined using microcosting methodology. Rehabilitation costs were estimated using reference prices. RESULTS: Hospital costs averaged €6813 per child. Labor (50%), overheads (29%), and medical aids (15%) were important cost drivers. Rehabilitation costs were estimated at €3599 per child. CONCLUSIONS: Surgery of the upper extremity is an important contributor to the healthcare costs of children with CP. Our study shows that labor is the most important cost driver for hospital costs, owing to the multidisciplinary approach and patient-specific treatment plan. A remarkable finding was the substantial amount of rehabilitation costs.

[PMID: 27055081](#)

7. IEEE Trans Neural Syst Rehabil Eng. 2016 Mar 24. [Epub ahead of print]

A Trunk Support System to Identify Posture Control Mechanisms in Populations Lacking Independent Sitting.

Goodworth AD, Wu YH, Felmlee D, Dunkleberger E, Saavedra S.

Populations with moderate-to-severe motor control impairments often exhibit degraded trunk control and/or lack the ability to sit unassisted. These populations need more research, yet their underdeveloped trunk control complicates identification of neural mechanisms behind their movements. The purpose of this study was to overcome this barrier by developing the first multi-articulated trunk support system to identify visual, vestibular, and proprioception contributions to posture in populations lacking independent sitting. The system provided external stability at a user-specific level on the trunk, so that body segments above the level of support required active posture control. The system included a tilting surface (controlled via servomotor) as a stimulus to investigate sensory contributions to postural responses. Frequency response and coherence functions between the surface tilt and trunk support were used to characterize system dynamics and indicated that surface tilts were accurately transmitted up to 5Hz. Feasibility of collecting kinematic data in participants lacking independent sitting was demonstrated in two populations: two typically developing infants, ~2-8 months, in a longitudinal study (8 sessions each) and four children with moderate-to-severe cerebral palsy (GMFCS III-V). Adaptability in the system was assessed by testing 16 adults (ages 18-63). Kinematic responses to continuous pseudorandom surface tilts were evaluated across 0.046-2Hz and qualitative feedback indicated that the trunk support and stimulus were comfortable for all subjects. Concepts underlying the system enable both research for, and rehabilitation in, populations lacking independent sitting.

[PMID: 27046877](#)

8. J Orthop. 2015 Nov 14;12(Suppl 2):S171-5. doi: 10.1016/j.jor.2015.10.017. eCollection 2015.

Comparison of single event vs multiple event soft tissue surgeries in the lower extremities with cerebral palsy.

Mahmudov V, Gunay H, Kucuk L, Coskunol E, Calis Atamaz F.

In children with spasticity of multiple muscle groups, the need for repeat surgical interventions increases with advancing age. AIM: The present study aimed to investigate retrospectively whether there are any clinical and functional differences between single-event multilevel surgeries and multiple surgical events at a single level. METHOD: The medical records of 109 patients with cerebral palsy (CP) were used. The patients, who met the inclusion and exclusion criteria, were assigned into following 4 groups based on the surgical procedures. The Gross Motor Function measure-88 (GMFCS) and Functional Independence Measure for Children (WeeFIM) were used for assessments. RESULTS: When compared to groups, there was no significant difference. This study showed that both surgical techniques resulted in improvements in GMFCS and WeeFIM levels. KEYWORDS: Cerebral palsy; Functional Independence Measure for Children; Spasticity; Surgery; The Gross Motor Function measure-88

[PMID: 27047219](#)

9. J Speech Lang Hear Res. 2016 Apr 8;1-14. doi: 10.1044/2015_JSLHR-S-15-0086. [Epub ahead of print]

Dysarthria in Adults With Cerebral Palsy: Clinical Presentation and Impacts on Communication.

Schölderle T, Staiger A, Lampe R, Strecker K, Ziegler W.

PURPOSE: Although dysarthria affects the large majority of individuals with cerebral palsy (CP) and can substantially complicate everyday communication, previous research has provided an incomplete picture of its clinical features. We aimed to comprehensively describe characteristics of dysarthria in adults with CP and to elucidate the impact of dysarthric symptoms on parameters relevant for communication. METHOD: Forty-two adults with CP underwent speech assessment by means of standardized auditory rating scales. Listening experiments were conducted to obtain communication-related parameters-that is, intelligibility and naturalness-as well as age and gender estimates. RESULTS: The majority of adults with CP showed moderate to severe dysarthria with symptoms on all dimensions of speech, most prominently voice quality, respiration, and prosody. Regression analyses revealed that articulatory, respiratory, and prosodic features were the strongest predictors of intelligibility and naturalness of speech. Listeners' estimates of the speakers' age and gender were predominantly determined by voice parameters. CONCLUSION: This study provides an overview on the clinical presentation of dysarthria in a convenience sample of adults with CP. The complexity of the functional impairment described and the consequences on the individuals' communication call for a stronger consideration of dysarthria in CP both in clinical care and in research.

[PMID: 27057824](#)

10. Orthop Traumatol Surg Res. 2016 Mar 31. pii: S1877-0568(16)00085-2. doi: 10.1016/j.otsr.2016.01.022. [Epub ahead of print]

Intramuscular psoas lengthening during single-event multi-level surgery fails to improve hip dynamics in children with spastic diplegia. Clinical and kinematic outcomes in the short- and medium-terms.

Mallet C, Simon AL, Ilharreborde B, Presedo A, Mazda K, Penneçot GF.

BACKGROUND: In children with spastic diplegia, hip extension in terminal stance is limited by retraction of the psoas muscle, which decreases stride propulsion and step length on the contralateral side. Whether intramuscular psoas lengthening (IMPL) is effective remains controversial. The objective of this study was to assess the impact of IMPL as a component of single-event multi-level surgery (SEMLS) on spatial and temporal gait parameters, clinical hip flexion deformity, and hip flexion kinematics. HYPOTHESIS: IMPL as part of SEMLS does not significantly improve hip flexion kinematics. MATERIALS AND METHODS: A retrospective review was conducted of the medical charts of consecutive ambulatory children with cerebral palsy who had clinical hip flexion deformity ($>10^\circ$) with more than 10° of excess hip flexion in terminal stance and who underwent SEMLS. The groups with and without IMPL were compared. Preoperative values of the clinical hip flexion contracture, hip flexion kinematics in terminal stance, and spatial and temporal gait parameters were compared to the values recorded after a mean postoperative follow-up of 2.4 ± 2.0 years (range, 1.0-8.7 years). Follow-up was longer than 3 years in 6 patients. RESULTS: Of 47 lower limbs (in 34 patients) included in the analysis, 15 were managed with IMPL. There were no significant between-group differences at baseline. Surgery was followed in all limbs by significant decreases in kinematic hip flexion and in the Gillette Gait Index. In the IMPL group, significant improvements occurred in clinical hip

flexion deformity, walking speed, and step length. The improvement in kinematic hip extension was not significantly different between the two groups. Crouch gait recurred in 3 (8%) patients. **DISCUSSION:** The improvement in kinematic hip extension in terminal stance was not significantly influenced by IMPL but was, instead, chiefly dependent on improved knee extension and on the position of the ground reaction vector after SEMLS. IMPL remains indicated only when the clinical hip flexion deformity exceeds 20°.

[PMID: 27050557](#)

11. Phys Occup Ther Pediatr. 2016 Apr 8:1-15. [Epub ahead of print]

Effects of Botulinum Toxin-A and Goal-Directed Physiotherapy in Children with Cerebral Palsy GMFCS Levels I & II.

Löwing K, Thews K, Haglund-Åkerlind Y, Gutierrez-Farewik EM.

AIMS: To evaluate short and long-term effects of botulinum toxin-A combined with goal-directed physiotherapy in children with cerebral palsy (CP). **METHOD:** A consecutive selection of 40 children, ages 4-12 years, diagnosed with unilateral or bilateral CP, and classified in GMFCS levels I-II. During the 24 months, 9 children received one BoNT-A injection, 10 children two injections, 11 children three injections, and 10 children received four injections. 3D gait analysis, goal-attainment scaling, and body function assessments were performed before and at 3, 12, and 24 months after initial injections. **RESULTS:** A significant but clinically small long-term improvement in gait was observed. Plantarflexor spasticity was reduced after three months and remained stable, while passive ankle dorsiflexion increased after 3 months but decreased slightly after 12 months. Goal-attainment gradually increased, reached the highest levels at 12 months, and levels were maintained at 24 months. **CONCLUSION:** The treatments' positive effect on spasticity reduction was identified, but did not relate to improvement in gait or goal-attainment. No long-term positive change in passive ankle dorsiflexion was observed. Goal attainment was achieved in all except four children. The clinical significance of the improved gait is unclear. Further studies are recommended to identify predictors for positive treatment outcome.

[PMID: 27058177](#)

12. PLoS One. 2016 Apr 4;11(4):e0152930. doi: 10.1371/journal.pone.0152930. eCollection 2016.

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.

AIM: Cerebral palsy (CP) is associated with dysfunction of the upper motor neuron and results in balance problems and asymmetry during locomotion. Selective dorsal rhizotomy (SDR) is a surgical procedure that results in reduced afferent neuromotor signals from the lower extremities with the aim of improving gait. Its influence on balance and symmetry has not been assessed. The aim of this prospective cohort study was to evaluate the impact of SDR on balance and symmetry during walking. **METHODS:** 18 children (10 girls, 8 boys; age 6 years (y) 3 months (m), SD 1y 8m) with bilateral spastic CP and Gross Motor Function Classification System levels I to II underwent gait analysis before and 6 to 12 months after SDR. Results were compared to 11 typically developing children (TDC; 6 girls, 5 boys; age 6y 6m, SD 1y 11m). To analyse balance, sway velocity, radial displacement and frequency were calculated. Symmetry ratios were calculated for balance measures and spatio-temporal parameters during walking. **RESULTS:** Most spatio-temporal parameters of gait, as well as all parameters of balance, improved significantly after SDR. Preoperative values of symmetry did not vary considerably between CP and TDC group and significant postoperative improvement did not occur. **INTERPRETATION:** The reduction of afferent signalling through SDR improves gait by reducing balance problems rather than enhancing movement symmetry.

[PMID: 27043310](#)

Prevention and Cure

13. *Behav Brain Res.* 2016 Mar 30. pii: S0166-4328(16)30142-5. doi: 10.1016/j.bbr.2016.03.017. [Epub ahead of print]

Consumption of Broccoli Sprouts During Late Gestation and Lactation Confers Protection Against Developmental Delay Induced By Maternal Inflammation.

Nguyen AT, Bahry AM, Shen KQ, Armstrong EA, Yager JY.

BACKGROUND: The presence of a fetal inflammatory response is linked to cerebral palsy. Unfortunately no preventive therapies are available. In this study, we determined whether dietary supplementation with broccoli sprouts (BrSp), a phase-II enzyme inducer, would be effective in preventing the behavioral and pathologic manifestations in a rodent model of inflammation during late pregnancy. **METHODS:** Pregnant Long-Evans rats were administered i.p. Injections of saline (100 μ l) or lipopolysaccharide (LPS, 200 μ g/kg), every 12hours on embryonic day (E) 19 and 20. In the treatment groups, dams were supplemented with 200mg/day of dried BrSp from E14 until postnatal day 21. Pups underwent a series of neurodevelopmental reflex tests from postnatal day 3 to 21 followed by neuropathological analyses. **RESULTS:** Pups born from the LPS group were significantly growth restricted ($p<0.001$) and delayed in hindlimb placing ($p<0.05$), cliff avoidance ($p<0.05$), and gait ($p<0.001$) compared to controls. In the open field behavior analyses, LPS pups had an increase in grooming behavior ($p<0.05$) and a decreased amount of time spent in the center of the box compared to controls. Dietary supplementation with BrSp to offspring exposed to LPS had increased birth weights ($p<0.001$), were no longer delayed in acquiring hindlimb placing, cliff avoidance, gait, and posture, and groomed less compared to LPS alone pups ($p<0.01$). Histological analyses revealed that LPS pups had reduced myelin basic protein compared to controls. **CONCLUSIONS:** Our data suggest that BrSp dietary supplementation during pregnancy may be effective in preventing growth restriction and neurodevelopmental delays.

[PMID: 27038765](#)

14. *Dev Neurorehabil.* 2016 Apr 8:1-13. [Epub ahead of print]

Perspectives on classification of selected childhood neurodisabilities based on a review of literature.

Jeevanantham D, Bartlett D.

PURPOSE: Classifying children with heterogeneous health conditions is challenging. The purposes of this perspective are to explore the prevailing classifications in children with the three selected neurodisabilities using the underlying framework of ICF/ICF-CY, explore the utility of the identified classifications, and make recommendations aimed at improving classifications. **METHODS:** A literature search on six databases and Google was conducted. Articles published between the years 2000 and 2013 were included if they provided information on classification of cerebral palsy (CP), and/or developmental coordination disorder (DCD) and/or autism spectrum disorders (ASD). **RESULTS:** Children with DCD and ASD are classified using combinations of multiple measures. The classifications in CP meet more of the proposed criteria for utility than those in DCD and ASD. **CONCLUSION:** None of the existing classifications addressed all the criteria. The heterogeneity associated with the selected neurodisabilities poses major challenges. Further work is required to establish improved classifications.

PMID: 27057781

15. *IEEE Trans Neural Syst Rehabil Eng.* 2016 Mar 8. [Epub ahead of print]

Frequency Analysis and Feature Reduction Method For Prediction of Cerebral Palsy in Young Infants.

Rahmati H, Martens H, Aamo OM, Stavdahl O, Stoen R, Adde L.

The aim of this paper is to achieve a model for prediction of cerebral palsy based on motion data of young infants. The prediction is formulated as a classification problem to assign each of the infants to one of the healthy or with cerebral palsy groups. Unlike formerly proposed features that are mostly defined in the time domain, this study proposes a set of features derived from frequency analysis of infants' motions. Since cerebral palsy affects the variability of the motions, and frequency analysis is an intuitive way of studying variability, suggested features are suitable and consistent with the nature of the condition. In the current application, a wellknow problem, few subjects and many features, was initially encountered. In such a case, most clas-

sifiers get trapped in a sub-optimal model and, consequently, fail to provide sufficient prediction accuracy. To solve this problem, a feature selection method that determines features with significant predictive ability is proposed. The feature selection method decreases the risk of false discovery and, therefore, the prediction model is more likely to be valid and generalizable for future use. A detailed study is performed on the proposed features and the feature selection method: the classification results confirm their applicability. Achieved sensitivity of 86%, specificity of 92% and accuracy of 91% are comparable with state of the art clinical and expert-based methods for predicting cerebral palsy.

[PMID: 27046852](#)

16. Iran J Child Neurol. 2016 Winter;10(1):35-41.

Cerebral Palsy in 1-12 Year Old Children in Southern Iran.

Inaloo S, Katibeh P, Ghasemof M.

OBJECTIVE: Cerebral palsy (CP) is a non-progressive CNS disorder due to an insult to the growing brain, usually occurring in the first two years of life. During the recent years, its etiology has been changed; perinatal and postnatal insults are not considered as its main causes in developed countries any more. The aim of this study was to evaluate the causes of CP in children in southern Iran. **MATERIALS & METHODS:** Overall, 200 children with CP aged 1-12 yr old referring to Pediatric Neurology Clinic affiliated to Shiraz University of Medical Sciences, Shiraz, Iran between 2012 and 2013 were enrolled. In addition, 200 healthy age and sex-matched children were considered as the control group. Exclusion criteria were isolated movement disorders with no other evidence of CP, progressive neurologic disorders, metabolic disorders, and incomplete or uncertain past history. After collecting the data on pregnancy period, prenatal history and past medical problems, they were analyzed with appropriate statistical methods. **RESULTS:** Maternal age, medical problems during pregnancy period, route of delivery, head circumference at birth, neonatal admission, neonatal jaundice, and prematurity were the main risk factors for CP. **DISCUSSION:** The distribution of risk factors of CP is different from that of developed countries in our region. Pre- and perinatal etiologies are still among the common causes of CP in Iran.

[PMID: 27057186](#)

17. Mutat Res Rev Mutat Res. 2016 Jan-Mar;767:42-58. doi: 10.1016/j.mrrev.2015.12.002. Epub 2016 Jan 4.

The importance of de novo mutations for pediatric neurological disease-It is not all in utero or birth trauma.

Erickson RP.

The advent of next generation sequencing (NGS, which consists of massively parallel sequencing to perform TGS (total genome sequencing) or WES (whole exome sequencing)) has abundantly discovered many causative mutations in patients with pediatric neurological disease. A surprisingly high number of these are de novo mutations which have not been inherited from either parent. For epilepsy, autism spectrum disorders, and neuromotor disorders, including cerebral palsy, initial estimates put the frequency of causative de novo mutations at about 15% and about 10% of these are somatic. There are some shared mutated genes between these three classes of disease. Studies of copy number variation by comparative genomic hybridization (CGH) preceded the NGS approaches but they also detect de novo variation which is especially important for ASDs. There are interesting differences between the mutated genes detected by CGS and NGS. In summary, de novo mutations cause a very significant proportion of pediatric neurological disease.

[PMID: 27036065](#)

18. Neonatology. 2016 Apr 7;110(1):47-54. [Epub ahead of print]

Early Conventional MRI for Prediction of Neurodevelopmental Impairment in Extremely-Low-Birth-Weight Infants.

Slaughter LA, Bonfante-Mejia E, Hintz SR, Dvorchik I, Parikh NA.

BACKGROUND: Extremely-low-birth-weight (ELBW; $\leq 1,000$ g) infants are at high risk for neurodevelopmental impairments. Conventional brain MRI at term-equivalent age is increasingly used for prediction of outcomes. However, optimal prediction models remain to be determined, especially for cognitive outcomes. **OBJECTIVE:** The aim was to evaluate the

accuracy of a data-driven MRI scoring system to predict neurodevelopmental impairments. **METHODS:** 122 ELBW infants had a brain MRI performed at term-equivalent age. Conventional MRI findings were scored with a standardized algorithm and tested using a multivariable regression model to predict neurodevelopmental impairment, defined as one or more of the following at 18-24 months' corrected age: cerebral palsy, bilateral blindness, bilateral deafness requiring amplification, and/or cognitive/language delay. Results were compared with a commonly cited scoring system. **RESULTS:** In multivariable analyses, only moderate-to-severe gyral maturational delay was a significant predictor of overall neurodevelopmental impairment (OR: 12.6, 95% CI: 2.6, 62.0; $p < 0.001$). Moderate-to-severe gyral maturational delay also predicted cognitive delay, cognitive delay/death, and neurodevelopmental impairment/death. Diffuse cystic abnormality was a significant predictor of cerebral palsy (OR: 33.6, 95% CI: 4.9, 229.7; $p < 0.001$). These predictors exhibited high specificity (range: 94-99%) but low sensitivity (30-67%) for the above outcomes. White or gray matter scores, determined using a commonly cited scoring system, did not show significant association with neurodevelopmental impairment. **CONCLUSIONS:** In our cohort, conventional MRI at term-equivalent age exhibited high specificity in predicting neurodevelopmental outcomes. However, sensitivity was suboptimal, suggesting additional clinical factors and biomarkers are needed to enable accurate prognostication.

[PMID: 27050735](#)

19. Neural Plast. 2016;2016:4901014. doi: 10.1155/2016/4901014. Epub 2016 Mar 7.

Plasticity in the Neonatal Brain following Hypoxic-Ischaemic Injury.

Rocha-Ferreira E, Hristova M.

Hypoxic-ischaemic damage to the developing brain is a leading cause of child death, with high mortality and morbidity, including cerebral palsy, epilepsy, and cognitive disabilities. The developmental stage of the brain and the severity of the insult influence the selective regional vulnerability and the subsequent clinical manifestations. The increased susceptibility to hypoxia-ischaemia (HI) of periventricular white matter in preterm infants predisposes the immature brain to motor, cognitive, and sensory deficits, with cognitive impairment associated with earlier gestational age. In term infants HI causes selective damage to sensorimotor cortex, basal ganglia, thalamus, and brain stem. Even though the immature brain is more malleable to external stimuli compared to the adult one, a hypoxic-ischaemic event to the neonate interrupts the shaping of central motor pathways and can affect normal developmental plasticity through altering neurotransmission, changes in cellular signalling, neural connectivity and function, wrong targeted innervation, and interruption of developmental apoptosis. Models of neonatal HI demonstrate three morphologically different types of cell death, that is, apoptosis, necrosis, and autophagy, which crosstalk and can exist as a continuum in the same cell. In the present review we discuss the mechanisms of HI injury to the immature brain and the way they affect plasticity.

[PMID: 2704769](#)

20. Neurotoxicology. 2016 Apr 1. pii: S0161-813X(16)30043-2. doi: 10.1016/j.neuro.2016.03.021. [Epub ahead of print]

Onset Factors in Cerebral Palsy: A Systematic Review.

van Lieshout P, Candundo H, Martino R, Shin S, Barakat-Haddad C.

Studies have noted several factors associated with the occurrence of Cerebral Palsy (CP), yet considerable uncertainty remains about modifiable factors related to disease onset. A systematic review was performed to identify existing systematic reviews and primary studies pertaining to targeted factors associated with the onset of CP. The following databases were searched: MEDLINE, MEDLINE In Process, EMBASE, PsycINFO, Scopus, Web of Science, Cochrane Database of Systematic Reviews, CINAHL, ProQuest Dissertations & Theses, Huge Navigator, AARP Ageline. Variations of MeSH and keyword search terms were used. Critical appraisal was conducted on selected articles. Data extraction targeted reported factors, risk estimates, and 95% confidence intervals (CI). Findings identified two systematic reviews and three meta-analyses, as well as 83 studies of case control, cohort, and cross-sectional methodological designs. Selected studies indicated that lower gestational age was associated with the onset of CP. Medical diagnoses for the mother, in particular chorioamnionitis, was found to be positively associated with onset of CP. Preeclampsia was reported to be either inconclusive or positively associated with CP onset. Low birth weight predominantly indicated a positive association with the onset of CP, while male gender showed mixed findings. The combination of male gender with pre-term or low birth weight was also found to be positively associated with CP. Evidence was identified in the literature pertaining to specific factors relating to the onset of CP, in particular showing positive associations with lower gestational age and low birth weight.

[PMID: 27045882](#)

21. Disabil Rehabil. 2016 Apr 4:1-7. [Epub ahead of print]**A combined surveillance program and quality register improves management of childhood disability.**

Alriksson-Schmidt AI, Arner M, Westbom L, Krumlinde-Sundholm L, Nordmark E, Rodby-Bousquet E, Hägglund G.

PURPOSE: To describe a concept for prevention of secondary conditions in individuals with chronic neuromuscular disabilities by using two Swedish developed follow-up-programmes for cerebral palsy (CP; CPUP) and myelomeningocele (MMC; MMCUP) respectively as examples. **METHOD:** This paper describes and outlines the rationale, development and implementation of CPUP and MMCUP. **RESULTS:** Both programmes are multidisciplinary longitudinal follow-up programmes that simultaneously serve as national registries. The programmes are population-based and set in Swedish habilitation clinics. Most children (95%) born 2000 or later with CP are enrolled in CPUP and the recruitment of adults is underway. CPUP has also been implemented in Norway, Denmark, Iceland, Scotland and parts of Australia. In MMCUP, almost all children with MMC born 2007 or later participate and individuals of all ages are now invited. The registries provide epidemiological profiles associated with CP and MMC and platforms for population-based research and quality of care improvement. **CONCLUSIONS:** Through multidisciplinary follow-up and early detection of emerging complications individuals with CP or MMC can receive less complex and more effective interventions than if treatment is implemented at a later stage. Possibilities and challenges to design, implement and continuously run multidisciplinary secondary prevention follow-up programmes and quality registries for individuals with CP or MMC are described and discussed. Implications for rehabilitation Individuals with disabilities such as cerebral palsy or myelomeningocele are at risk of developing secondary conditions. Multidisciplinary population-based longitudinal follow-up programmes seem effective in preventing certain types of secondary conditions.

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