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Interventions and Management

1. Development of hand function during the first year of life in children with unilateral cerebral palsy.

Sakzewski L, Sicola E, Verhage CH, Sgandurra G, Eliasson AC.

Dev Med Child Neurol. 2018 Nov 8. doi: 10.1111/dmcn.14091. [Epub ahead of print]

AIM: To identify developmental trajectories of hand function in infants aged 3 months to 12 months with unilateral cerebral palsy (CP). **METHOD:** Infants at high risk of unilateral CP were recruited from 3 months of age from follow-up programmes and clinics in Sweden, the Netherlands, Italy, and Australia. Measurements on the Hand Assessment for Infants (HAI) were completed until 12 months of age. Group-based trajectory modelling was used to identify subgroups of infants with similar trajectories of development. Multinomial logistic regression determined associations between demographic variables and trajectory membership. **RESULTS:** Ninety-seven infants (52 males, 45 females; median gestational age 38wks [interquartile range 30-40wks]) were included. Infants were assessed between two and seven times (mean 4, SD 1.2) with a total of 387 observations. A three-group trajectory model identified a 'low-functioning group' (n=45: 46%), 'moderate-functioning group' (n=30: 31%), and 'high-functioning group' (n=22: 23%). Mean posterior probabilities (0.91-0.96) and odds of correct classification (26.3-33.2) indicated good model fit. Type of brain lesion, sex, side of hemiplegia, country, gestational age, and access to intensive intervention were not associated with group membership. **INTERPRETATION:** Three trajectories of hand function development for infants with unilateral CP were identified and indicate some greater distinctions between groups with increasing age. The HAI is a valuable measure, capturing development of hand function of infants with unilateral CP over time. **WHAT THIS PAPER ADDS:** Three distinct developmental trajectories of hand function in infants with unilateral cerebral palsy were identified. A low-functioning group made little progress in development of hand function in the first year of life. The degree of impairment on the impaired hand at 6 months of age is highly associated with trajectory membership. Infants with all types of brain lesion were represented across each trajectory group.

PMID: [30411327](#)

2. Assessment of upper limb use in children with typical development and neurodevelopmental disorders by inertial sensors: a systematic review.

Braitto I, Maselli M, Sgandurra G, Inguaggiato E, Beani E, Cecchi F, Cioni G, Boyd R.

J Neuroeng Rehabil. 2018 Nov 6;15(1):94. doi: 10.1186/s12984-018-0447-y.

Understanding development of bimanual upper limb (UL) activities in both typical and atypical conditions in children is important for: i) tailoring rehabilitation programs, ii) monitoring progress, iii) determining outcomes and iv) evaluating effectiveness of treatment/rehabilitation. Recent technological advances, such as wearable sensors, offer possibilities to perform standard medical monitoring. Body-worn motion sensors, mainly accelerometers, have shown very promising results but, so far, these studies have mainly focused on adults. The main aim of this review was to report the evidence of UL activity

of both typically developing (TD) children and children with neurodevelopmental disorders (NDDs) that are reliably reported and comparable, using a combination of multiple wearable inertial sensors, both in laboratory and natural settings. Articles were selected from three research databases (PubMed, Web of Science and EBSCO). Included studies reported data on children aged 0-20 years old simultaneously wearing at least two inertial sensors on upper extremities. The collected and reported data were relevant in order to describe the amount of physical activity performed by the two ULs separately. A total of 21 articles were selected: 11 including TD, and 10 regarding NDDs. For each article, a review of both clinical and technical data was performed. We considered inertial sensors used for following aims: (i) to establish activity intensity cut-points; (ii) to investigate validity and reliability of specified markers, placement and/or number of inertial sensors; (iii) to evaluate duration and intensity of natural UL movements, defined motor tasks and tremor; and (iv) to assess efficacy of certain rehabilitation protocols. Our conclusions were that inertial sensors are able to detect differences in use between both hands and that all reviewed studies support use of accelerometers as an objective outcome measure, appropriate in assessing UL activity in young children with NDDs and determining intervention effectiveness. Further research on responsiveness to interventions and consistency with use in real-world settings is needed. This information could be useful in planning UL rehabilitation strategies.

PMID: [30400992](#)

3. Correlation analysis of motor function improvement and brain structure for upper limb paralysis.

Ueda R, Yamada N, Abo M, Senoo A.

Neuroreport. 2018 Nov 5. doi: 10.1097/WNR.0000000000001160. [Epub ahead of print]

Intervention with combined low-frequency repetitive transcranial magnetic stimulation and intensive occupational therapy can improve brain function in poststroke patients with motor paralysis. We aimed to evaluate the relationship between brain structure at the time of intervention and the degree of motor function improvement using this combination therapy. Twenty-five patients with upper limb paralysis after stroke were hospitalized for 15 days to receive 12 sessions of low-frequency repetitive transcranial magnetic stimulation over the nonlesional hemisphere and occupational therapy. Imaging analysis was carried out using three-dimensional T1-weighted images. Correlation analysis between cortical thickness and upper limb motor function score was carried out using FreeSurfer. Correlation analysis between cortical thickness and motor function improvement was carried out by atlas-based analysis. FreeSurfer showed that significant positive correlations were found between cortical thickness of the postcentral or supramarginal gyrus of the diseased hemisphere and motor function improvements in nondominant hand paralysis (uncorrected $P < 0.001$). Results using the atlas supported these results ($P < 0.05$). The results of the analysis indicated that the effect of our proposed treatment could be related to the cortical thickness. In particular, it is considered that the cortical thickness of the postcentral gyrus or the supramarginal gyrus of the affected hemisphere plays an important role in such recovery in poststroke hemiparetic patients.

PMID: [30399028](#)

4. Brain-machine interface cursor position only weakly affects monkey and human motor cortical activity in the absence of arm movements.

Stavisky SD, Kao JC, Nuyujukian P, Pandarinath C, Blabe C, Ryu SI, Hochberg LR, Henderson JM, Shenoy KV.

Sci Rep. 2018 Nov 5;8(1):16357. doi: 10.1038/s41598-018-34711-1.

Brain-machine interfaces (BMIs) that decode movement intentions should ignore neural modulation sources distinct from the intended command. However, neurophysiology and control theory suggest that motor cortex reflects the motor effector's position, which could be a nuisance variable. We investigated motor cortical correlates of BMI cursor position with or without concurrent arm movement. We show in two monkeys that subtracting away estimated neural correlates of position improves online BMI performance only if the animals were allowed to move their arm. To understand why, we compared the neural variance attributable to cursor position when the same task was performed using arm reaching, versus arms-restrained BMI use. Firing rates correlated with both BMI cursor and hand positions, but hand positional effects were greater. To examine whether BMI position influences decoding in people with paralysis, we analyzed data from two intracortical BMI clinical trial participants and performed an online decoder comparison in one participant. We found only small motor cortical correlates, which did not affect performance. These results suggest that arm movement and proprioception are the major contributors to position-related motor cortical correlates. Cursor position visual feedback is therefore unlikely to affect the performance of BMI-driven prosthetic systems being developed for people with paralysis.

PMID: [30397281](#)

5. Gross Motor Function Classification System Specific Growth Charts-Utility as a Risk Stratification Tool for Surgical Site Infection Following Spine Surgery.

Baranek ES, Maier SP, Matsumoto H, Hyman JE, Vitale MG, Roye DP Jr, Roye BD.

J Pediatr Orthop. 2018 Nov 2. doi: 10.1097/BPO.0000000000001285. [Epub ahead of print]

BACKGROUND: There is currently minimal evidence that preoperative malnutrition increases surgical site infection (SSI) risk in children with cerebral palsy (CP) undergoing spinal deformity surgery. Growth charts specifically for patients with CP have been created to aid in the clinical interpretation of body mass index (BMI) as a marker of nutritional status, but to our knowledge these charts have never been used to risk stratify patients before orthopaedic surgery. We hypothesize that patients with CP who have BMI-for-age below the 10th percentile ($BMI \leq 10$) on CP-specific growth charts are at increased risk of surgical site infection following spinal deformity surgery compared with patients with BMI-for-age above the 10th percentile ($BMI > 10$). **METHODS:** Single-center, retrospective review comparing the rate of SSI in patients with CP stratified by BMI-for-age percentiles on CP-specific growth charts who underwent spinal deformity surgery. Odds ratios with 95% confidence intervals and Pearson χ tests were used to analyze the association of the measured nutritional indicators with SSI. **RESULTS:** In total, 65 patients, who underwent 74 procedures, had complete follow-up data and were included in this analysis. Ten patients (15.4%) were GMFCS I-III and 55 (84.6%) were GMFCS IV-V; 39 (60%) were orally fed and 26 (40%) were tube-fed. The rate of SSI in this patient population was 13.5% with 10 SSIs reported within 90 days of surgery. There was a significant association between patients with a BMI below the 10th percentile on GMFCS-stratified growth charts and the development of SSI (OR, 13.6; 95% CI, 2.4-75.4; $P=0.005$). All SSIs occurred in patients that were GMFCS IV-V. There was no association between height, weight, feeding method, or pelvic instrumentation and development of SSI. **CONCLUSIONS:** CP-specific growth charts are useful tools for identifying patients at increased risk for SSI following spinal instrumentation procedures, whereas standard CDC growth charts are much less sensitive. There is a strong association between preoperative BMI percentile on GMFCS-stratified growth charts and SSI following spinal deformity surgery. **LEVEL OF EVIDENCE:** Level III-Retrospective Study.

PMID: [30395003](#)

6. Does acupuncture help patients with spasticity? A narrative review

Zhu Y, Yang Y, Li J.

Ann Phys Rehabil Med. 2018 Nov 5. pii: S1877-0657(18)31477-5. doi: 10.1016/j.rehab.2018.09.010. [Epub ahead of print]

Spasticity is a motor disorder encountered after upper motor neuron lesions. It adversely affects quality of life in most patients and causes long-term burden of care and has significant financial implications. The effect of conventional therapies for spasticity including physical therapy, surgery, and pharmacotherapy are not always satisfying because of the short-term effects or side effects in some patients. Acupuncture is a part of traditional medicine originating from China. It has been used to resolve functional recovery problems after central nervous system injury for many years in Asian countries and is increasingly popular in western countries. Some research suggest that acupuncture has therapeutic potential to help improve limb movement function and decrease the severity of spasticity. This review synthesizes studies involving stroke, brain injury, spinal cord injury, cerebral palsy, and multiple sclerosis to give an overall picture of the effect and potential mechanisms of acupuncture on spasticity occurring after upper motor neuron lesions. Moderate-quality evidence suggests that electroacupuncture combined with conventional routine care (pharmacological/rehabilitation) could reduce spasticity and improve motor function and activities in daily living after stroke. However, there is not enough evidence to conclude that acupuncture (including electroacupuncture) could reduce spasticity with other central nervous system diseases.

PMID: [30408516](#)

7. Spontaneous infant movements that predict later cerebral palsy: reply to Hadders-Algra and Philippi.

Kwong AKL, Olsen JE, FitzGerald TL, Doyle LW, Cheong JLY, Spittle AJ.

Dev Med Child Neurol. 2018 Dec;60(12):1289. doi: 10.1111/dmcn.14036.

PMID: [30393857](#)

8. Neuromuscular characterisation in Cerebral Palsy using hybrid Hill-type models on isometric contractions.

Wiedemann LG, Jayaneththi VR, Kimpton J, Chan A, Müller MA, Hogan A, Lim E, Wilson NC, McDaid AJ.

Comput Biol Med. 2018 Nov 1;103:269-276. doi: 10.1016/j.combiomed.2018.10.027. [Epub ahead of print]

BACKGROUND: Muscles of individuals with Cerebral Palsy (CP) undergo structural changes over their lifespan including an increase in muscle stiffness, decreased strength and coordination. Being able to identify these changes non-invasively would be beneficial to improve understanding of CP and assess therapy effectiveness over time. This study aims to adapt an existing EMG-driven Hill-type muscle model for neuromuscular characterisation during isometric contractions of the elbow joint. **METHODS:** Participants with (n = 2) and without CP (n = 8) performed isometric force ramps with contraction levels ranging between 15 and 70% of their maximum torque. During these contractions, high-density EMG data were collected from the M. Biceps and Triceps brachii with 64 electrodes on each muscle. The EMG-driven Hill-type muscle model was used to predict torques around the elbow joint, and muscle characterisation was performed by applying a genetic algorithm that tuned individuals' parameters to reduce the RMS error between observed and predicted torque data. **RESULTS:** Observed torques could be predicted accurately with an overall mean error of $1.24\text{Nm} \pm 0.53\text{Nm}$ when modelling individual force ramps. The first four parameters of the model could be identified relatively reliably across different experimental protocols with a full-scale variation of below 20%. **CONCLUSION:** An HD-EMG muscle modelling approach to evaluating neuromuscular properties in participants with and without CP has been presented. This pilot study confirms the feasibility of the experimental protocol and demonstrates some parameters can be identified robustly using the isometric contraction force ramps.

PMID: [30408656](#)**9. Individualized evaluation of lumbar bone mineral density in children with cerebral palsy.**

Duran I, Katzmann J, Martakis K, Stark C, Semler O, Schoenau E.

Arch Osteoporos. 2018 Nov 5;13(1):120. doi: 10.1007/s11657-018-0531-8.

Lumbar spine bone mineral density (LS-BMD) assessed by dual-energy X-ray absorptiometry (DXA) is used in children with cerebral palsy (CP) to evaluate bone health. LS-BMD results in children with CP are influenced significantly by their height, BMI, and mobility level. An adjustment for these parameters might improve the clinical significance of the method. **PURPOSE/INTRODUCTION:** DXA evaluation is considered useful in children with CP to assess bone health. For this purpose, LS-BMD is often used. The aim of the study was to estimate the effect of height, BMI, and reduced mobility level of children with CP on LS-BMD and to develop a method to adjust individual results of LS-BMD for these factors. **METHODS:** We conducted a monocentric retrospective analysis of data collected in children and adolescents with CP, who participated in a rehabilitation program and had no history of recurrent fractures. The DXA scan was part of the routine examination for participants older than 4 years of age. The relationship between height and BMI for age Z-scores and age-adjusted LS-BMD Z-scores was analyzed. **RESULTS:** LS-DXA scans of 500 children and adolescents with CP (Gross Motor Function Classification System levels I-V) were included in the statistical analysis (217 female). The mean age was 9.4 years (± 3.7 years). Children with moderate to severe CP had significantly ($p < 0.001$) lower LS-BMD Z-scores than children with mild CP. We provided nomograms to adjust individual LS-BMD results to their height, BMI, and mobility level. **CONCLUSIONS:** LS-BMD results in children with CP were influenced significantly by their height, BMI, and mobility level. An adjustment of the LS-BMD results to height, BMI, and mobility level might improve the clinical significance of an individual result.

PMID: [30397843](#)**10. Alterations of treatment-naïve pelvis and thigh muscle morphology in children with cerebral palsy.**

Massaad A, Assi A, Bakouny Z, Bizdikian AJ, Skalli W, Ghanem I.

J Biomech. 2018 Oct 27. pii: S0021-9290(18)30799-1. doi: 10.1016/j.jbiomech.2018.10.022. [Epub ahead of print]

Lower limb (LL) muscle morphology and growth are altered in children with cerebral palsy (CP). Muscle alterations differ with age and with severity of motor impairment, classified according to the gross motor classification system (GMFCS). Muscle alterations differ also with orthopedic intervention, frequently performed at the level of the shank muscles since an early age, such as the gastrocnemius. The aim was to investigate the alterations of treatment-naïve pelvis and thigh muscle lengths and volumes in children with GMFCS levels I and II, of varying ages. 17 children with CP (GMFCS I: N = 9, II: N = 8, age: 11.7 ± 4 years), age-matched to 17 typically developing (TD) children, underwent MRI of the LL. Three-dimensional reconstructions of the muscles were performed bilaterally. Muscle volumes and lengths were calculated in 3D and compared

between groups. Linear regression between muscle volumes and age were computed. Adductor-brevis and gracilis lengths, as well as rectus-femoris volume, were decreased in GMFCS I compared to TD ($p < 0.05$). Almost all the reconstructed muscle volumes and lengths were found to be altered in GMFCS II compared to TD and GMFCS I. All muscle volumes showed significant increase with age in TD and GMFCS I (R^2 range: 0.3-0.9, $p < 0.05$). Rectus-femoris, hamstrings and adductor-longus showed reduced increase in the muscle volume with age in GMFCS II when compared to TD and GMFCS I. Alterations of treatment-naïve pelvis and thigh muscle volumes and lengths, as well as muscle growth, seem to increase with the severity of motor impairment in ambulant children with CP.

PMID: [30389259](#)

11. Immediate effect of kinesio taping on knee extensor torque of children with Cerebral Palsy: Three case reports.

Dos Santos AN, Rocha NACF.

NeuroRehabilitation. 2018 Nov 8. doi: 10.3233/NRE-161921. [Epub ahead of print]

BACKGROUND: Kinesiotaping (KT) has been commonly used in clinical setting. However, beneficial KT effects have not been proved yet. **OBJECTIVE:** We aimed to verify the effects of KT in knee extensor torque in children with CP. **METHODS:** We evaluated three children diagnosed as spastic CP, classified as level I, II and III, according with GMFCS. Knee extensor peak torque was analyzed by isokinetic evaluation (Biodex Multi Joint System). The test was performed at 60°/s in the concentric passive mode and the children performed maximal contractions. Children with CP were evaluated with and without KT under rectus femoris. **RESULTS:** After KT application, knee peak torque of the affected limb increased in children with CP. **CONCLUSION:** KT may increase muscle strength in children with CP.

PMID: [30412508](#)

12. Impaired Ability to Suppress Excitability of Antagonist Motoneurons at Onset of Dorsiflexion in Adults with Cerebral Palsy.

Geertsen SS, Kirk H, Nielsen JB.

Neural Plast. 2018 Oct 9;2018:1265143. doi: 10.1155/2018/1265143. eCollection 2018.

We recently showed that impaired gait function in adults with cerebral palsy (CP) is associated with reduced rate of force development in ankle dorsiflexors. Here, we explore potential mechanisms. We investigated the suppression of antagonist excitability, calculated as the amount of soleus H-reflex depression at the onset of ankle dorsiflexion compared to rest, in 24 adults with CP (34.3 years, range 18-57; GMFCS 1.95, range 1-3) and 15 healthy, age-matched controls. Furthermore, the central common drive to dorsiflexor motoneurons during a static contraction in the two groups was examined by coherence analyses. The H-reflex was significantly reduced by 37% at the onset of dorsiflexion compared to rest in healthy adults ($P < 0.001$) but unchanged in adults with CP ($P = 0.91$). Also, the adults with CP had significantly less coherence. These findings suggest that the ability to suppress antagonist motoneuronal excitability at movement onset is impaired and that the central common drive during static contractions is reduced in adults with CP.

PMID: [30402086](#)

13. Postanesthesia alteration of lower limb contractures in children with spastic cerebral palsy.

Lai YC, Lin HS, Pan HF, Chang WN, Hsu CJ, Renn JH, Kuo TJ.

J Pediatr Orthop B. 2018 Nov 1. doi: 10.1097/BPB.0000000000000565. [Epub ahead of print]

The aim of this study was to clarify the effects of general anesthesia (GA) on joint range of motion (ROM) in children with spastic cerebral palsy (SCP). Eighty-four SCP cases (mean age 8.4 years) admitted for first corrective surgery were retrospectively reviewed. Lower limb ROM were measured 1 day before operation and immediately after GA. Contracture of hip, knee, and ankle joints decreased significantly after GA, with +11.1° (39.5%) for the hip abduction angle, -3.7° (18.0%) for the Thomas test, -15.0° (19.1%) for the popliteal angle, +6.6° (39.8%) and 7.0° (109%) for ankle dorsiflexion with knee flexion and extension, respectively (all $P < 0.001$). These changes were correlated positively to pre-GA contracture and body weight, negatively to age, but independent of preoperative functional level, geographic classification of SCP, or modified Ashworth

scale. On the basis of these findings, routine post-GA reassessments of joint ROM before corrective surgeries were recommended for pediatric SCP cases.

PMID: [30395002](#)

14. Improving gait and lower-limb muscle strength in children with cerebral palsy following selective percutaneous myofascial lengthening and functional physiotherapy.

Skoutelis VC, Kanellopoulos A, Vrettos S, Gkrimas G, Kontogeorgakos V.

NeuroRehabilitation. 2018 Nov 2. doi: 10.3233/NRE-182468. [Epub ahead of print]

BACKGROUND: Selective Percutaneous Myofascial lengthening (SPML) is an innovative minimally invasive surgical procedure, using micro incisions often combined with alcohol nerve block, for managing muscle contractures and stiffness in children with cerebral palsy (CP). There is lack of evidence of effects of a combined intervention of SPML and physiotherapy on gait function and muscle strength in CP. **OBJECTIVE:** This study investigated the change in gait function and muscle strength in children with CP who underwent gait laboratory assessment before and after SPML, combined with obturator nerve blocks, and 9-month post-surgical functional physiotherapy. **METHODS:** Ten children with bilateral spastic CP, Gross Motor Function Classification System (GMFCS) level II-IV, age 5-7 years, participated in this study. The Global Gait Graph Deviation Index (Global GGDI) and isometric muscle strength (hand-held dynamometry) were the primary outcome measures. Changes in spatiotemporal gait parameters, gross motor function and GMFCS level were secondarily examined. **RESULTS:** A significant improvement of Global GGDI was found ($p < 0.05$). The mean strength in hip flexors, extensors and adductors, knee extensors, and ankle dorsiflexors increased significantly ($p < 0.05$). Children improved significantly their GMFCS level and gross motor capacity ($p < 0.05$). **CONCLUSIONS:** SPML procedure combined with functional physiotherapy can improve gait function and lower-limb muscle strength.

PMID: [30400115](#)

15. Repeatability of electromyography recordings and muscle synergies during gait among children with cerebral palsy.

Steele KM, Munger ME, Peters KM, Shuman BR, Schwartz MH.

Gait Posture. 2018 Oct 22;67:290-295. doi: 10.1016/j.gaitpost.2018.10.009. [Epub ahead of print]

BACKGROUND: Clinical gait analysis is commonly used in the evaluation and treatment of children with cerebral palsy (CP). While the repeatability of kinematic and kinetic measures of gait has previously been evaluated, the repeatability of electromyography (EMG) recordings or measures calculated from EMG data, such as muscle synergies, remains unclear for this population. **RESEARCH QUESTION:** Are EMG recordings and muscle synergies from clinical gait analysis repeatable between visits for children with CP? **METHODS:** We recruited 20 children with bilateral CP who had been referred for clinical gait analysis. The children completed two visits less than six weeks apart with EMG data collected bilaterally from five muscles (rectus femoris, medial hamstrings, vastus lateralis, anterior tibialis, and medial gastrocnemius). Variance ratio and cosine similarity were used to evaluate repeatability of EMG waveforms between visits. Nonnegative matrix factorization was used to calculate synergies from EMG data at each visit to compare synergy weights and activations. **RESULTS & SIGNIFICANCE:** The inter-visit variance ratios of EMG data for children with CP were similar to previously reported results for typically-developing children and unimpaired adults (range: 0.39 for vastus lateralis to 0.66 for rectus femoris). The average cosine similarity of the EMG waveforms between visits was greater than 0.9 for all muscles, while synergy weights and activations also had high similarity - greater than 0.8 and 0.9 between visits, respectively. These results demonstrate that EMG repeatability between visits during clinical gait analysis for children with CP is similar to unimpaired individuals. These results provide a baseline for evaluating whether observed changes in EMG recordings between visits reflect real changes in muscle activity or are within the range of inter-visit variability.

PMID: [30396059](#)

16. Estimating the effect size of surgery to improve walking in children with cerebral palsy from retrospective observational clinical data.

Rajagopal A, Kidziński Ł, McGlaughlin AS, Hicks JL, Delp SL, Schwartz MH.

Sci Rep. 2018 Nov 5;8(1):16344. doi: 10.1038/s41598-018-33962-2.

Single-event multilevel surgery (SEMLS) is a standard treatment approach aimed at improving gait for patients with cerebral palsy, but the effect of this approach compared to natural progression without surgical intervention is unclear. In this study, we used retrospective patient history, physical exam, and three-dimensional gait analysis data from 2,333 limbs to build regression models estimating the effect of SEMLS on gait, while controlling for expected natural progression. Post-hoc classifications using the regression model results identified which limbs would exhibit gait within two standard deviations of typical gait at the follow-up visit with or without a SEMLS with 73% and 77% accuracy, respectively. Using these models, we found that, while surgery was expected to have a positive effect on 93% of limbs compared to natural progression, in only 37% of limbs was this expected effect a clinically meaningful improvement. We identified 26% of the non-surgically treated limbs that may have shown a clinically meaningful improvement in gait had they received surgery. Our models suggest that pre-operative physical therapy focused on improving biomechanical characteristics, such as walking speed and strength, may improve likelihood of positive surgical outcomes. These models are shared with the community to use as an evaluation tool when considering whether or not a patient should undergo a SEMLS.

PMID: [30397268](#)

17. Physical fitness of non-disabled school-aged children born with extremely low birth weights.

Tamai K, Nishihara M, Hirata K, Shiraishi J, Hirano S, Fujimura M, Yano S, Kanazawa T, Kitajima H.

Early Hum Dev. 2018 Oct 27;128:6-11. doi: 10.1016/j.earlhumdev.2018.10.008. [Epub ahead of print]

BACKGROUND: The assessment of long-term outcomes in survivors born with extremely low birth weights (ELBWs) has become increasingly important. However, little has been reported on the physical fitness of non-disabled school-aged children born with ELBWs. **AIMS:** To assess the physical fitness of non-disabled school-aged children born with ELBWs. **STUDY DESIGN:** Retrospective cohort study. **SUBJECTS:** We analyzed 169 ELBW infants without cerebral palsy or intellectual disability (based on the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) Full Scale intelligence quotient (IQ) test < 70). **OUTCOME MEASURES:** Physical fitness was assessed using the grip strength, sit-up repetitions, sit & reach, side steps, standing long jump, and softball throw tests. T-scores were calculated using national survey data. **RESULTS:** The T-scores for the grip strength, sit-up repetitions, sit & reach, side steps, standing long jump, softball throw tests, and the overall T-score were 43.7 ± 7.5 , 44.2 ± 10.5 , 46.0 ± 9.7 , 40.9 ± 8.0 , 40.0 ± 9.8 , 42.4 ± 8.1 , and 42.9 ± 5.5 , respectively. After adjusting for other age-related factors, the height (SD score), WISC-III Performance IQ score, and percent predicted forced vital capacity (FVC) independently predicted the overall T-scores. Their standardized partial regression coefficients (β) were 0.334 ($p = 0.009$), 0.190 ($p = 0.022$), and 0.187 ($p = 0.032$), respectively. **CONCLUSIONS:** Our cohort's physical fitness at approximately 8 years of age was significantly impaired compared to average Japanese children of the same age. Height, FVC, and Performance IQ independently predicted physical fitness, with height being the strongest predictor.

PMID: [30392918](#)

18. PI3K-Akt-Wnt Pathway Is Implicated in Exercise-Induced Improvement of Short-term Memory in Cerebral Palsy Rats.

Cho JW, Jung SY, Kim DY, Chung YR, Choi HH, Jeon JW, Han JH.

Int Neurol J. 2018 Oct;22(Suppl 3):S156-164. doi: 10.5213/inj.1836224.112. Epub 2018 Oct 31.

PURPOSE: Maternal lipopolysaccharide (LPS) injection induces neurodevelopmental disorders, such as cerebral palsy. Exercise activates phosphatidylinositol 3-kinase (PI3K)-protein kinase B (Akt) signaling pathway that enhances neurogenesis. Wnt ligands are also implicated in the hippocampal neurogenesis and synaptic plasticity. Glycogen synthase kinase-3 β (GSK-3 β) is a downstream molecule of Akt, and GSK-3 β is known to modulate hippocampal neurogenesis negatively. **METHODS:** Cerebral palsy was made by maternal LPS-injection. On the 5 weeks after birth, treadmill running was applied to the rat pups of the exercise groups, for 30 minutes, 5 times a week during 6 weeks. **RESULTS:** Treadmill running alleviated short-term memory impairments of the cerebral palsy rat pups. Hippocampal cell proliferation was increased and hippocampal apoptosis was suppressed by treadmill running in the cerebral palsy rat pups. Hippocampal phosphorylated-PI3K/PI3K ratio, phosphorylated-Akt/Akt ratio, and Wnt expression were enhanced by treadmill running in the cerebral palsy rat pups. In contrast, hippocampal phosphorylated-GSK-3 β /GSK-3 β ratio and β -catenin expression were suppressed by treadmill running in the cerebral palsy rat pups. **CONCLUSION:** The results of this study showed that short-term memory improvement due to treadmill running in cerebral palsy occurs via activation of the PI3K-Akt-Wnt pathway.

PMID: [30396265](#)

19. Prevalence and Characteristic Features of Deep Venous Thrombosis in Patients with Severe Motor and Intellectual Disabilities.

Ohmori H, Kanaoka Y, Yamasaki M, Takesue H, Sumimoto R.

Ann Vasc Dis. 2018 Sep 25;11(3):281-285. doi: 10.3400/avd.oa.18-00028.

Sudden death associated with patients with severe motor and intellectual disabilities (SMID) have been thought to be caused in part by venous thromboembolism (VTE), but actual situation of VTE in SMID is not clear. We examined the prevalence and location of deep venous thrombosis (DVT), and the relation of the development of crural veins in 16 patients with SMID, using ultrasonography. The maximum diameter of soleal vein was 1.6 ± 0.5 mm. In most cases, DVT was found in the femoral veins. We could not detect thrombus in the soleal veins. In the present study, the detection ratio of DVT was high in patients with SMID who had restricted mobility capability and were bedridden, and we found the veins centrally from popliteal veins in DVT in SMID, not soleal veins, as the initial sites of the DVT. In the literature, the mean diameter of soleal veins, in healthy adults is 6.7 ± 1.8 mm, that in contrast in SMID being smaller. Underdevelopment of intramuscular veins is possibly related to the mechanism of DVT in SMID. In the current guidelines for the management of VTE, there is limited in scope of ambulatory adults and no application cases who exhibit to SMID restricted mobility of the lower extremities and are bedridden associated with cerebral palsy and developmental motor disabilities, and such patients have associated high risk of the complications of DVT. According to our present study, it is necessary to provide appropriate guidelines for DVT in SMID considering characteristic features. (This is a translation of Jpn J Phlebol 2017; 28: 29-34.).

PMID: [30402176](#)

20. Feeding and swallowing impairment in children with stroke and unilateral cerebral palsy: a systematic review.

Sherman V, Greco E, Moharir M, Beal D, Thorpe K, Martino R.

Dev Med Child Neurol. 2018 Nov 9. doi: 10.1111/dmcn.14094. [Epub ahead of print]

AIM: This systematic review targeted frequency estimates of dysphagia (feeding and swallowing problems), related health outcomes, and caregiver burden in children with stroke or unilateral cerebral palsy (CP). **METHOD:** Six electronic databases were searched from their inception to November 2017 along with a manual search of eight relevant journals. Two blinded raters assessed abstracts and full articles for eligibility. Discrepancies were resolved by consensus. Accepted articles were evaluated for quality. Data were extracted and analysed descriptively. **RESULTS:** Of 1660 abstracts, five met inclusion criteria, of which three focused on stroke and two unilateral CP. Across studies, operational definitions of feeding and swallowing varied. Insufficient details were provided on assessment methods and timing. Reported frequencies of dysphagia ranged from 24.2% to 88.6%. One study reported dysphagia-related health outcomes and none reported caregiver burden. **INTERPRETATION:** These results suggest that dysphagia is common in children with stroke and unilateral CP; however, its frequency is yet unknown as is its impact on health and caregiver burden. Availability of a standardized tool to identify dysphagia in these children accurately is a recommended first step to address this evidence gap. **WHAT THIS PAPER ADDS:** There is limited data on the incidence of dysphagia after childhood stroke and unilateral cerebral palsy. Available evidence shows reported dysphagia frequencies from 24.2% to 88.6%. Only one study reported on dysphagia-related health outcomes. No study reported on caregiver burden.

PMID: [30411334](#)

21. Food Habits, Dietary Intake, and Body Composition in Children with Cerebral Palsy.

Kim HJ, Choi HN, Yim JE.

Clin Nutr Res. 2018 Oct;7(4):266-275. doi: 10.7762/cnr.2018.7.4.266. Epub 2018 Oct 29.

This study aimed to determine meal-related factors affecting nutritional status, dietary intake, and body composition of children with cerebral palsy (CP). This study was conducted on 16 children with and 16 children without CP, aged 4 to 12 years, through a survey on general characteristics, body composition, eating habits, and nutrient intake. In the case of children with CP, comparisons were made according to classification into types of paralysis (hemiplegia, paraplegia, and quadriplegia). With respect to stature, the percentile of those surveyed was within normal range; however, children with CP were in a significantly lower percentile ($p < 0.05$) than healthy children. Regarding problems of dietary life, while usually brain-damaged children with CP have an overeating problem, seriously brain-damaged children with CP cannot have a meal by themselves; this was significantly different among the groups ($p < 0.01$). Regarding average intake of vitamin D and calcium, children with and

without CP had a lower intake than required, with no significant difference between the groups. The evaluation of the nutrient status of children with and children without CP showed that children with CP were slow in stature development, and intake of vitamin D and calcium were less than required; therefore, it is necessary to provide education on adequate intake of nutrients. Since CP leads to frequent external intervention to having meals, it is required of parents and teachers to undergo training on adequate eating habits and attitudes.

PMID: [30406056](#)

22. Assessment of nutritional status in children with cerebral palsy.

Gumus E, Ozen H.

Clin Nutr ESPEN. 2018 Dec;28:243-244. doi: 10.1016/j.clnesp.2018.08.016. Epub 2018 Sep 5.

PMID: [30390890](#)

23. The effect of caffeine loading on cerebral autoregulation in preterm infants.

Huvanandana J, Thamrin C, Hinder M, McEwan A, Tracy M.

Acta Paediatr. 2018 Nov 7. doi: 10.1111/apa.14636. [Epub ahead of print]

AIM: To evaluate cerebral autoregulation changes in preterm infants receiving a loading dose of caffeine base. METHODS: In a cohort of 30 preterm infants, we extracted measures of cerebral autoregulation using time and frequency domain techniques to determine the correlation between mean arterial pressure (MAP) and tissue oxygenation index (TOI) signals. These measures included the cerebral oximetry index (COx), cross-correlation and coherence measures, and were extracted prior to caffeine loading and in the 2 hours following administration of 10 mg/kg caffeine base. RESULTS: We observed acute reductions in time domain correlation measures, including the cerebral oximetry index (linear mixed-model coefficient -0.093, standard error 0.04; $p = 0.028$) and the detrended cross-correlation coefficient (ρ_5 coefficient -0.13, standard error 0.055; $p = 0.025$). These reductions suggested an acute improvement in cerebral autoregulation. Features from detrended cross-correlation analysis also showed greater discriminative value than other methods in identifying changes prior to and following caffeine administration. CONCLUSION: We observed a reduced correlation between MAP and TOI from near-infrared spectroscopy following caffeine administration. These findings suggest an acute enhanced capacity for cerebral autoregulation following a loading dose of caffeine in preterm infants, contributing to our understanding of the physiological impact of caffeine therapy. This article is protected by copyright. All rights reserved.

PMID: [30403427](#)

24. Incidence of Epilepsy and Associated Risk Factors in Perinatal Ischemic Stroke Survivors.

Rattani A, Lim J, Mistry AM, Prablek MA, Roth SG, Jordan LC, Shannon CN, Naftel RP.

Pediatr Neurol. 2018 Sep 21. pii: S0887-8994(18)30497-1. doi: 10.1016/j.pediatrneurol.2018.08.025. [Epub ahead of print]

INTRODUCTION: Epilepsy is a serious and often lifelong consequence of perinatal arterial ischemic stroke (PAIS). Variable incidences and risk factors for long-term epilepsy in PAIS have been reported. To determine the incidence of epilepsy in PAIS survivors and report factors associated with the risk of developing epilepsy, a meta-analysis and systematic review of prior publications was performed. METHODS: We examined studies on perinatal or neonatal patients (≤ 28 days of life) with arterial ischemic strokes in which the development of epilepsy was reported. EMBASE and MEDLINE/PubMed databases were systematically searched in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. RESULTS: A meta-analysis of 10 studies revealed a summary incidence of epilepsy in PAIS patients of 27.2% (95% confidence interval 16.6% to 41.4%) over a mean study duration of 10.4 years (range 1.5 to 17). More recent studies generally reported a lower epilepsy incidence. A systematic review identified seven possible risk factors for epilepsy in PAIS patients: hippocampal volume reduction, infarct on prenatal ultrasound, a modified Alberta Stroke Program Early Computed Tomography score ≥ 9 , family history of seizures, cerebral palsy, and initial presentation with cognitive impairment or seizures. CONCLUSIONS: About a third of children with PAIS will develop epilepsy. While seven possible risk factors have been reported, further research is warranted to confirm the strength of their association with the development of epilepsy.

PMID: [30409458](#)

25. Epidemiology of cerebral palsy in Bangladesh: a population-based surveillance study.

Khandaker G, Muhit M, Karim T, Smithers-Sheedy H, Novak I, Jones C, Badawi N.

Dev Med Child Neurol. 2018 Nov 5. doi: 10.1111/dmcn.14013. [Epub ahead of print]

AIM: To examine the prevalence, clinical characteristics, and risk factors of cerebral palsy (CP) in children in Bangladesh. **METHOD:** The Bangladesh CP Register is an ongoing population-based surveillance database of children with CP from a geographically defined area in Bangladesh. Cases were defined based on Surveillance of CP in Europe and Australian CP Register criteria after clinical assessments and identification by the key informant's method. **RESULTS:** In total, 726 children with CP were identified between January 2015 and December 2016. Mean age was 7 years 7 months (standard deviation [SD] 4y 6mo; range: 4.8mo-18y; median 7y 1.2mo; 61.8% male, 38.2% female). Mean age at CP diagnosis was 5 years 2 months (SD 3.8). Observed prevalence was 3.4 per 1000 children (95% confidence interval [CI]: 3.2-3.7), resulting in an estimated 233 514 children (95% CI: 219 778-254 118) with CP in Bangladesh. The majority (79.6%) had spastic CP. Altogether, 79.6% of the children with CP had at least one associated impairment (speech 67.6%, intellectual 39.0%, epilepsy 23.7%, visual 10.2%, and hearing 10.2%). In total, 78.2% never received rehabilitation. **INTERPRETATION:** In Bangladesh, the burden of CP is high, and diagnosis is substantially delayed, limiting opportunities for early intervention. There is a lack of available services and the majority of the children had preventable risk factors. **WHAT THIS PAPER ADDS:** Prevalence of cerebral palsy (CP) is 3.4 per 1000 children in rural Bangladesh. There are an estimated 233 514 children with CP in Bangladesh. The majority have potentially preventable risk factors. Diagnosis of CP is delayed, limiting opportunities for early intervention. There is a lack of available services for children with CP in rural Bangladesh.

PMID: [30394528](#)**26. Disability Registration State of Children With Cerebral Palsy in Korea.**

Kim SW, Jeon HR, Kim Y, Choi SJ, Youk T, Kim J.

Ann Rehabil Med. 2018 Oct;42(5):730-736. doi: 10.5535/arm.2018.42.5.730. Epub 2018 Oct 31.

OBJECTIVE: To investigate the disability registration state of children with cerebral palsy (CP) in Korea. **METHODS:** Based on the National Health Information Database, the disability registration state was examined for brain lesion disability and other possible complicated disabilities accompanying brain disorder in children diagnosed with CP aged up to 5 years old who were born between 2002 and 2008. **RESULTS:** Of children diagnosed with CP, 73.1% were registered as having brain lesion disability for the first time before they turned 2 years old. The younger the children, the more likely they will have 1st and 2nd degree disability. However, when the age of children is increased, such likelihood is decreased. The percentage of children registered as having overlapping disabilities was 7%-20%. **CONCLUSION:** It is important to establish a more accurate standard to rate disability and provide national support systems for children with CP with various severities and multiple disabilities. By reorganizing the current disability registration system for pediatric brain lesions, the system could serve as a classification standard to provide medical and social welfare services.

PMID: [30404422](#)**27. Cost of Rehabilitation Treatment of Patients With Cerebral Palsy in Korea.**

Kim SW, Jeon HR, Youk T, Kim J.

Ann Rehabil Med. 2018 Oct;42(5):722-729. doi: 10.5535/arm.2018.42.5.722. Epub 2018 Oct 31.

OBJECTIVE: To investigate rehabilitation treatment cost of patients with cerebral palsy (CP) according to age. **METHODS:** We analyzed the cost of rehabilitation treatment from 2007 to 2013 for patients diagnosed with CP by sourcing data from the National Health Information Database. **RESULTS:** While the number of recently born children requiring rehabilitation treatment has decreased, the number of patients requiring this treatment in other age groups has gradually increased. In addition, annual physical therapy, occupational therapy, hydrotherapy, and botulinum toxin injection treatment costs per person have increased. On the other hand, the number of orthopedic surgeries and selective dorsal rhizotomy performed has decreased. **CONCLUSION:** This study investigated trends in the cost of treatment for patients with CP. This study can be used as a basis to provide treatment support for patients with CP.

PMID: [30404421](#)

28. Measures of health-related quality of life outcomes in pediatric neurosurgery: literature review.

Desai VR, Gadgil N, Saad S, Raskin JS, Lam SK.

World Neurosurg. 2018 Nov 3. pii: S1878-8750(18)32501-4. doi: 10.1016/j.wneu.2018.10.194. [Epub ahead of print]

BACKGROUND: Improving value in healthcare means optimizing outcomes while minimizing costs. The emerging pay-for-performance era requires understanding the impact of healthcare services on health-related quality of life (HRQoL). Pediatric and surgical subspecialties have yet to fully integrate HRQoL measures into practice. This study aims to review and characterize the HRQoL outcome measures across various pediatric neurosurgical diagnoses. **METHODS:** A literature review was performed by searching PubMed and Google Scholar with search terms such as "health-related quality of life" and "pediatric neurosurgery" and then including the specific pathologies for which a HRQoL instrument was found (for example: "health-related quality of life" + "epilepsy"). Each measurement was evaluated based on content and purpose, relative strengths and weaknesses, and validity. **RESULTS:** 68 articles were reviewed. Epilepsy, brain tumor, cerebral palsy, spina bifida, hydrocephalus, and scoliosis were diagnoses with published studies using disease-specific HRQoL instruments. General HRQoL instruments were also reported. Internal, test-retest, and/or inter-rater reliability varied across instruments, as did face, content, concurrent, and/or construct validity. Few instruments have been tested enough for robust reliability and validity. Significant variability exists in usage of these instruments in clinical studies within pediatric neurosurgery. **CONCLUSIONS:** HRQoL instruments reported in pediatric neurosurgery are currently without standardized guidelines and thus exhibit high variability in use. Clinicians should support the development and application of these methodologies to optimize these instruments, promote standardization of research, improve performance measures to reflect clinically modifiable and meaningful measures, and ultimately lead the national discussion in healthcare quality and patient-centered care.

PMID: [30399472](https://pubmed.ncbi.nlm.nih.gov/30399472/)