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Interventions and Management

1. Estimating Forearm Axial Rotation Using Vive Trackers for Interaction with Serious Games.

Nai W, Feng J, Shan L, Jia F, Sun M, Sun X.

IEEE Trans Neural Syst Rehabil Eng. 2019 Jul 29. doi: 10.1109/TNSRE.2019.2931778. [Epub ahead of print]

One of the most common upper limb dysfunction seen among cerebral palsy children is the limited supination or pronation of the forearm, thus training forearm axial rotation is a common demand for interventions. We propose a method to estimate forearm axial rotation using commercially available tracking device HTC Vive tracker to support interaction with serious games with forearm axial rotation movement for rehabilitation in clinic or home environment. The proposed method provides an easy-to-access and affordable way for forearm axial angle estimation when arm is at different positions relative to torso and when tracking devices are worn in different orientations. Effectiveness of the proposed method is examined, and a serious game system that uses the method for interaction is designed which was installed in The First Hospital of Jilin University as an option of forearm movement practices for children with cerebral palsy.

PMID: [31369382](#)

2. The short-term effects of selective dorsal rhizotomy on gait compared to matched cerebral palsy control groups.

O'Sullivan R, Leonard J, Quinn A, Kiernan D.

PLoS One. 2019 Jul 30;14(7):e0220119. doi: 10.1371/journal.pone.0220119. eCollection 2019.

OBJECTIVES: To examine the short-term effects of selective dorsal rhizotomy (SDR) ± soft-tissue surgery on gait in cerebral palsy (CP) compared to matched controls with no surgical intervention. **METHODS:** Participants had gait analysis before and one year after SDR. Non SDR participants were retrospectively matched for age and all significant gait parameters. The SDR group was further subdivided into those who had concomitant orthopaedic surgery and those who had SDR only. **RESULTS:** The SDR group consisted of 29 participants (mean age 5.8 years at baseline, 7.7 years at follow-up). Of these, 13 had concomitant orthopaedic surgery. The non SDR group consisted of 18 participants (mean age at baseline 6.1 years, 8.1 years at follow-up). SDR ± soft-tissue surgery significantly improved step-lengths, knee flexion at initial contact and mid-stance, ankle dorsiflexion, foot progression and timing of peak knee flexion. None of these improvements in gait were seen without surgical intervention. While more improvements were seen in those who had SDR and orthopaedic surgery, SDR only resulted in improved step-lengths, knee extension, foot progression and timing of peak knee flexion. **CONCLUSIONS:** SDR ± soft-tissue surgery results in short-term improvements in gait which are not seen without surgical intervention. While those who had SDR and soft-tissue surgery demonstrated more changes in gait, many improvements were attributable to SDR only.

PMID: [31361785](#)

3. Pediatric complex care and surgery comanagement: Preparation for spinal fusion.

Berry JG, Glaspy T, Eagan B, Singer S, Glader L, Emara N, Cox J, Glotzbecker M, Crofton C, Ward E, Leahy I, Salem J, Troy M, O'Neill M, Johnson C, Ferrari L.

J Child Health Care. 2019 Jul 30;1367493519864741. doi: 10.1177/1367493519864741. [Epub ahead of print]

The aim of this study is to assess the impact of preoperative comanagement with complex care pediatricians (CCP) on children with neuromuscular scoliosis undergoing spinal fusion. We performed chart review of 79 children aged 5-21 years undergoing spinal fusion 1/2014-6/2016 at a children's hospital, with abstraction of clinical documentation from preoperative health evaluations performed regularly by anesthesiologists and irregularly by a CCP. Preoperative referrals to specialists, labs, tests, and care plans needed last minute for surgical clearance were measured. The mean age at surgery was 14 (SD 3) years; cerebral palsy (64%) was the most common neuromuscular condition. Thirty-nine children (49%) had a preoperative CCP evaluation a median 63 days (interquartile range (IQR) 33-156) before the preanesthesia visit. Children with CCP evaluation had more organ systems affected by coexisting conditions than children without an evaluation (median 11 (IQR 9-12) vs. 8 (IQR 5-11); $p < .001$). The rate of last-minute care coordination activities required for surgical clearance was lower for children with versus without CCP evaluation (1.8 vs. 3.6). A lower percentage of children with CCP evaluation required last-minute development of new preoperative plans (26% vs. 50%, $p = .002$). Children with CCP involvement were better prepared for surgery, requiring fewer last-minute care coordination activities for surgical clearance.

PMID: [31359785](#)

4. Investigation of the inter-dependence between intra-abdominal pressure and spinal stability.

Driscoll M, Blyum L.

Clin Biomech (Bristol, Avon). 2019 Jul 17;69:164-167. doi: 10.1016/j.clinbiomech.2019.07.018. [Epub ahead of print]

INTRODUCTION: Many researchers have explored the link between intra-abdominal pressure and the biomechanical stability of the spine. Children severely affected with cerebral palsy have low engagement of the abdominal region and correspondingly very poor spine stability. Rehabilitation programs often seek to improve such resources, but a link has never been objectively demonstrated in this patient population who may greatly benefit from potential gains. Thus, the purpose is to evaluate the interdependency between intra-abdominal pressure and spinal stability in cerebral palsy patients undergoing a targeted rehabilitation program. **METHODS:** A non-randomized prospective cohort treatment study of patients with gross motor function classification system types 4 and 5 over five years old while undergoing a high-frequency rehabilitation program targeting spinal stability. Blinded measures of intra-abdominal pressure and seated spinal stability were acquired. All measures were taken at baseline and bi-annually for 2 years. GMFCS classification were taken at baseline to distinguish the study group. Study directives were approved by independent ethical committees. Non-parametric Wilcoxon tests were utilized to perform data analyses. **FINDINGS:** Measures of intra-abdominal pressure, by way of customized indentometer, improved from 3.23 to 4.46 lbs./in. of compression between baseline and 24 months ($p < 0.05$). Seated spinal stability improved from scores of 2.3 to 3.1 after 24 months ($p < 0.05$). Results showed a trend of collinearity between intra-abdominal pressure and seated spinal stability. **INTERPRETATION:** Results suggest a correlation between intra-abdominal compression and, correspondingly, better seated spinal stability for GMFCS class 4 and 5 patients.

PMID: [31352257](#)

5. A pilot investigation of anterior tilt use among power wheelchair users.

Rice LA, Yarnot R, Mills S, Sonsoff J.

Disabil Rehabil Assist Technol. 2019 Jul 26:1-8. doi: 10.1080/17483107.2019.1644676. [Epub ahead of print]

Purpose: To examine the influence of use of the anterior tilt-in-space power seat function on performance of functional activities, physical health, and user satisfaction on among power wheelchair users. **Materials and methods:** Ten full-time power wheelchair users with a seat elevator on their current chair participated in a mixed-methods, repeated measures study. At Visit 1 participants completed the Wheelchair Outcome Measure, Functional Mobility Assessment, Wheelchair Users Shoulder Pain Index, Fatigue Severity Scale, and the Spinal Cord Injury Secondary Conditions Scale. Physical assessments were performed to examine transfer quality (transfer assessment instrument), functional reach, activities of daily living (performance assessment of self-care skills), seated balance (function in sitting test), spasticity, respiratory function, and speech production. Approximately 3 days later (Visit 2), participants were trained on use and provided a power wheelchair with anterior tilt to trial

for two weeks. After two weeks (Visit 3), the Visit 1 protocol was repeated and a semistructured interview conducted. Results: Participants lived with disabilities of cerebral palsy, spinal muscular atrophy and multiple sclerosis. With use of anterior tilt, significant improvements were seen among safety of meal preparation, $p = 0.033$, $d_z = 0.91$ and functional reach in the vertical direction, $p = 0.000$, $d_z = 2.62$. Subjectively, participants found anterior tilt helpful in performance of reaching tasks in but found the safety equipment restrictive. Conclusion: Preliminary results indicate that use of the anterior tilt may help to improve performance of functional activities. Additional research is needed to examine the long-term influence of the technology. Implications for rehabilitation The anterior tilt seat function changes the seat angle orientation in relation to the ground in the sagittal plane and angles the seat forward. As a result, the individual using the assistive technology is positioned in a semistanding position. Preliminary results of this study indicate that with use of anterior tilt, safety of meal preparation and functional reach in the vertical direction significantly improved. Subjectively, participants found anterior tilt helpful in performance of reaching tasks but found the safety equipment restrictive. Additional research is needed to examine the long-term influence of anterior tilt on functional activities, physical health and user satisfaction on among a large and diverse group of power wheelchair users.

PMID: [31348680](#)

6. Intra- and inter-tester reliability of spasticity assessment in standing position in children and adolescents with cerebral palsy using a paediatric exoskeleton.

Cherni Y, Ballaz L, Girardin-Vignola G, Begon M.

Disabil Rehabil. 2019 Aug 1:1-7. doi: 10.1080/09638288.2019.1646814. [Epub ahead of print]

Background: The L-STIFF tool of the Lokomat evaluates the hip and knee flexors and extensors spasticity in a standing position. It moves the lower limb at a controlled velocity, measuring joint resistance to passive movements. Since its reliability in children with cerebral palsy remains unknown, our goal was to evaluate the relative and absolute reliability of L-STIFF in children with cerebral palsy. Methods: Reliability was determined in 16 children with cerebral palsy by two experienced therapists. The changes in resistive torque in hip and knee in both flexion and extension were measured. Relative and absolute reliability were estimated using the intraclass correlation coefficient, standard error of measurement, and minimal detectable change. Reliability was assessed on three levels: (1) intra- and (2) inter-tester within session, and (3) intra-tester between sessions. Results: Intraclass correlation coefficients were moderate to excellent for intra-tester reliability (all $p \leq 0.01$). The standard error of measurement ranged from 0.005 to 0.021 Nm° (i.e., 7-16%) and minimal detectable change from 0.014 to 0.059 Nm° . Inter-tester intraclass correlation coefficients ranged from 0.32 to 0.70 (all $p \leq 0.01$), standard error of measurement ranged from 0.012 to 0.029 Nm° (i.e., 6-39%), and minimal detectable change ranged from 0.033 to 0.082 Nm° . L-STIFF reliability was better during fast and medium movement speeds compared to slow speeds. Conclusions: The assessment tool L-STIFF is a promising tool for quantifying lower limb spasticity in children with cerebral palsy in a standing position. However, the results should be interpreted carefully. Implications for Rehabilitation L-STIFF is a promising tool for evaluating lower limb spasticity in standing position. A special care must be given to the installation and alignment of the participant into the Lokomat to minimize erroneous spasticity measurement. Relative standard error of measurement and minimal detectable change should be used to analyze changes spasticity.

PMID: [31368379](#)

7. [Effectiveness of the use of standing devices in the prevention of hip dislocation in children and adolescents with spastic cerebral palsy, GMFCS III, IV and V. A systematic review].

Pérez Ramírez N1, Rozbaczyló Fuster C2, Nahuelhual Cares P3.

Rehabilitacion (Madr). 2019 Jul - Sep;53(3):169-180. doi: 10.1016/j.rh.2019.05.001. Epub 2019 Jul 9. [Article in Spanish]

The standing devices are used as a preventive therapy for hip dislocation in patients with cerebral palsy. This review seeks to assess the effectiveness of standing devices in the prevention of hip dislocation of patients under 18 years old with a diagnosis of spastic cerebral palsy, GMFCS III-V. A systematic search was conducted in 10 biomedical databases, selecting randomized, quasi-experimental clinical trials and cohort studies. The use of standing devices with physical therapy, orthosis and/or soft tissue surgeries was compared. The percentage of migration of the femoral head was considered as the main result. The risk of bias was assessed using the Rob 2.0 and Robins I guidelines. As a result of the analysis of 6 primary studies, it is obtained that the use of standing devices maintained the percentage of migration of the femoral head within normal limits (MP:13-23%, $p < .01$), increased vertebral trabecular volumetric bone mineral density (8.16mg/cm³, $p = .01$), bone mineral content ($p = .010$) and hamstring muscle length (phase B1 $p < .01$ and B2 $p = .03$). However, the risk of bias in these studies was categorized as of some concern to moderate. In conclusion, it is stated that there is limited evidence of the effectiveness of the use of standing devices in the prevention of hip dislocation in the study population, due to the methodological heterogeneity and risk of bias of

the included studies. A greater number of studies with a high level of evidence are required in order to generate a recommendation for its use. Registration in PROSPERO: CRD42018087641.

PMID: [31370944](#)

8. Factors associated with unaffected foot deformity in unilateral cerebral palsy.

Yoon JA, Jung DH, Lee JS, Kim SY, Shin YB.

J Pediatr Orthop B. 2019 Jul 29. doi: 10.1097/BPB.0000000000000665. [Epub ahead of print]

The aim of this study was to assess the angular components of the affected foot associated with valgus deformity of the unaffected foot and to redefine the actual leg-length inequality in unilateral cerebral palsy. We retrospectively reviewed the medical records and radiologic images of 76 patients with unilateral cerebral palsy. Weight-bearing plain radiography of both feet of each subject was obtained. Angular measurements focused on the collapse of the longitudinal arch, hind foot valgus and forefoot abduction. Patients were divided into two groups: with and without valgus deformity of the unaffected side. Leg-length discrepancy and pelvic obliquity angle were measured. Among 76 patients, 40 (52%) had valgus deformities of the unaffected side. Independent t-test revealed no significant differences in age, affected side, type of deformity on the affected side, or application of bilateral biomechanical foot orthosis between patients with or without valgus deformity of the unaffected side. Patients with valgus deformity had significantly increased voluntary ankle dorsiflexion greater than neutral on the affected side, leg-length discrepancy and lateral talocalcaneal angle ($P < 0.05$). Laterally measured foot angles of both feet were significantly correlated. The optimal cut-off points for predicting valgus deformity were leg-length discrepancy >10 mm or affected limb/unaffected limb-length index <0.98 . Leg-length discrepancy and lateral talocalcaneal angle of the affected foot were significantly increased in patients with valgus deformity of the unaffected side. The optimal cut-off point for predicting valgus deformity of the unaffected foot would be useful in clinical practice.

PMID: [31361705](#)

9. Changes in Walking Performance between Childhood and Adulthood in Cerebral Palsy: A Systematic Review.

Chiu HC, Ada L, Chen C.

Dev Neurorehabil. 2019 Jul 31:1-6. doi: 10.1080/17518423.2019.1648579. [Epub ahead of print]

Purpose: To examine the changes in walking performance between childhood and adulthood in cerebral palsy. **Methods:** Cohort studies were included if the participants were children with cerebral palsy at Gross Motor Function Classification System (GMFCS) Level I-IV, initial measurement of walking by 13 years of age and follow-up measurement by 30 years of age. **Results:** At GMFCS Level I+ II, 7% (95% CI 6-8) had declined to GMFCS Level III. At GMFCS Level III, 4% (95% CI 3-6) had declined to GMFCS Level IV and 31% (95% CI 27-34) had improved to GMFCS Level I+ II. At GMFCS Level IV, 2% (95% CI 1-4) had improved to GMFCS Level III and 3% (95% CI 2-4) had improved to GMFCS Level I+ II. **Discussion:** The results suggest that walking performance is stable from childhood to adulthood at either end of the spectrum of ability but is more changeable for intermediate walkers.

PMID: [31366265](#)

10. The Effect of a Low-Cost Body Weight-Supported Treadmill Trainer on Walking Speed and Joint Motion.

Ventura JD, Charrette AL, Roberts KJ.

Medicina (Kaunas). 2019 Jul 30;55(8). pii: E420. doi: 10.3390/medicina55080420.

Background and Objectives: Gait training with body weight-support has been shown to improve the walking speed of individuals with movement disorders. The AccesSportAmerica Gait Trainer is a low-cost, pre-market gait rehabilitation device that alters the stride characteristics of participants walking on a standard treadmill. The purpose of this study was to examine the biomechanical outcomes that training on this device has for people with brain injuries that affect motor functioning. It was hypothesized that there would be an increase in walking speed post-intervention, and that there would be an increase in step length and joint range-of-motion. **Materials and Methods:** An intervention study was conducted with 11 people with ambulatory difficulty caused by post-stroke hemiparesis ($n = 7$), traumatic brain injury ($n = 3$), and cerebral palsy ($n = 1$). The

average time using the AccesSportAmerica Gait Trainer was 34.5 (SD = 6.0) minutes per session for 36.9 (SD = 21.8) sessions. Gait speed, step length and time, and joint flexion were measured during the 10 Meter Walk Test. Results: From pre- to post-intervention, there was a mean increase in walking speed of 0.19 m/s (SD = 0.06, $p = 0.016$, $d = 0.40$) and a decrease in step time of both affected and unaffected legs (affected: $p = 0.011$, $d = 0.37$; unaffected: $p = 0.004$, $d = 0.67$). There was no significant change in stride length or joint angles. Conclusions: The AccesSportAmerica Gait Trainer has the potential to improve the walking speed of people with ambulatory difficulty.

PMID: [31366161](#)

11. Augmented Biofeedback Training with Physical Therapy Improves Visual-Motor Integration, Visual Perception, and Motor Coordination in Children with Spastic Hemiplegic Cerebral Palsy: A Randomised Control Trial.

Alwhaibi RM, Alsakhawi RS, ElKholi SM.

Phys Occup Ther Pediatr. 2019 Jul 31:1-18. doi: 10.1080/01942638.2019.1646375. [Epub ahead of print]

AIM: The aim of this study is to investigate the efficacy of combining augmented biofeedback training and standard therapy for improving visual-motor integration (VMI), visual perception (VP), and motor coordination (MC) in children with spastic cerebral palsy (CP). Methods: Participants were 45 children, 5-8 years of age, with spastic hemiplegic CP. They were randomized into three groups: group A followed a 3-month specially designed program physical therapy intervention to facilitate VMI and VP. Group B received augmented biofeedback training. Group C received augmented biofeedback training and the physical therapy program provided to group A. The treatment sessions lasted 60 min, three times a week for three months. The Beery-Buktenica Developmental Test of VMI and its supplemental tests were used to evaluate the children before and after the program. RESULTS: After a 3-month treatment, standard scores and age equivalent scores for VMI, VP, and MC were significantly higher in group C compared with group A. CONCLUSION: The combination of augmented biofeedback and physical therapy could be used to improve VMI, VP, and MC in children with spastic hemiplegic CP.

PMID: [31364896](#)

12. Increasing Number of Therapy Sessions of Repetitive Transcranial Magnetic Stimulation Improves Motor Development by Reducing Muscle Spasticity in Cerebral Palsy Children.

Rajak BL, Gupta M, Bhatia D, Mukherjee A.

Ann Indian Acad Neurol. 2019 Jul-Sep;22(3):302-307. doi: 10.4103/aian.AIAN_102_18.

BACKGROUND: Repetitive TMS (rTMS), a non-invasive neuro-stimulation tool based on the principle of electromagnetic induction is recently being employed both for investigational and interventional purposes. The stimulating effect of rTMS on motor cortex areas of the brain leads to increased motor activity and decreased muscle tone in spastic cerebral palsy (CP) patients. OBJECTIVE: This modulatory effect of rTMS is used in this study to evaluate its effect on motor function and spasticity by increasing the number of therapy session and keeping frequency of 10Hz and pulse train of 2500 constant. METHODS: Total thirty spastic CP patients participated in this study after written informed consent from their parents/guardians. The participants were equally divided into three groups, namely, S-20, S-30 and S-40 depending on the number of therapy sessions. The mean age \pm SD of participants in different groups were 8.9 \pm 3.6, 9.5 \pm 2.9 and 8.4 \pm 3.5 in S-20, S-30 and S-40 respectively. Participants in S-20, S-30 and S-40 were provided 20, 30 and 40 sessions of rTMS therapy respectively followed by physical therapy of 30 minutes daily. Each rTMS session was of 25 minutes duration and was administered once daily for 5 days a week. Prior to start and after completion of the therapy, pre and post assessment of gross motor function measure (GMFM) for motor function and modified Ashworth scale (MAS) for muscle spasticity was performed on all the participants. OUTCOMES: The result of pre-versus-post GMFM score showed that 4.27%, 3.12% and 2.36% motor gain was obtained after 40, 30 and 20 sessions of therapy respectively. In addition, significant reduction in spasticity in both upper and limb muscles was also observed in all the three groups.

PMID: [31359942](#)

13. Physical, occupational, and speech therapy for children with cerebral palsy.

McCoy SW Palisano R, Avery L, Jeffries L, Laforme Fiss A, Chiarello L, Hanna S.

Dev Med Child Neurol. 2019 Jul 28. doi: 10.1111/dmcn.14325. [Epub ahead of print]

AIM: To explore the relationship between rehabilitation therapies and development in children with cerebral palsy (CP). **METHOD:** We conducted a prospective, longitudinal study involving 656 children with CP (mean age [SD] 6y [2y 8mo] at study entry; 1y 6mo-11y 11mo; 287 females, 369 males), and their parents. Children were assessed two to five times over 2 years by therapists using standardized measures of balance and walking endurance. Parents completed questionnaires on demographics, rehabilitation therapies, and their children's performance in self-care and participation in recreation. Therapists and parents collaboratively classified children's Gross Motor Function Classification System (GMFCS) levels. We created longitudinal graphs for each GMFCS level, depicting change across time using centiles. Using multinomial models, we analyzed the relationship between therapies (amount, focus, family-centeredness, and the extent therapies met children's needs) and whether change in balance, walking endurance, and participation was 'more than' and 'less than' the reference of 'as expected'. **RESULTS:** Children were more likely to progress 'more than expected' when participating in recreation when therapies were family-centered, met children's needs, and focused on structured play/recreation. A focus on health and well-being was positively associated with participation and self-care. The amount of therapy did not predict outcomes. **INTERPRETATION:** Therapy services that are family-centered, consider the needs of the child, and focus on structured play/recreational activities and health/well-being may enhance the development of children with CP.

PMID: [31353456](#)

14. Prevalence and severity of malnutrition in pediatric neurology outpatients with respect to underlying diagnosis and comorbid nutrition and feeding related problems.

Tekin H, Tekgöl H, Yılmaz S, Arslangiray D, Reyhan H, Serdaroğlu G, Gökben S.

Turk J Pediatr. 2018;60(6):709-717. doi: 10.24953/turkjped.2018.06.012.

Tekin H, Tekgöl H, Yılmaz S, Arslangiray D, Reyhan H, Serdaroğlu G, Gökben S. Prevalence and severity of malnutrition in pediatric neurology outpatients with respect to underlying diagnosis and co-morbid nutrition and feeding related problems. Turk J Pediatr 2018; 60: 709-717. This study aimed to determine prevalence and severity of malnutrition with respect to underlying diagnosis and co-morbid nutrition and feeding related problems in pediatric neurology outpatients. A total of 1,057 pediatric neurology outpatients (7.2±5.4 years, 56.9% males) were included. Data on patient demographics, neurological diagnosis, anthropometrics and Nutritional Questionnaire (NQ) for co-morbid feeding difficulties and nutritional problems were recorded. Epilepsy (45.2%) was the most common diagnosis, while prevalence of acute malnutrition was 17.7%. Nutritional support resulted in a significant decrease in the percentage of malnourished patients (from 17.1% to 6.7%, p<0.001) and significant improvement in weight for height scores (increased to 81.42±8.17, p=0.045). In NQ-10 item assessment, at least one item was positive in 66.0% (gastrointestinal in 54.3%) of acutely malnourished patients, more commonly in severe acute malnutrition. NQ 4- item set of 'red flags' revealed that prolonged meal time, meal time stressful to child or parent, lack of weight gain not just weight loss and cough during feeding were evident in 45.2%, 46.8%, 36.7% and 14.8% of patients with acute malnutrition, respectively; and more common in patients with severe malnutrition. NQ 4-item set of 'red flags' was associated with high sensitivity (95%) and specificity (88%) in detection of malnutrition. In conclusion, our findings in a cohort of pediatric neurology outpatients revealed that 17.1% of overall patients were acutely malnourished along with higher prevalence of malnutrition in underlying diagnosis of cerebral palsy and higher likelihood of nutritional problems and feeding difficulties in severe malnutrition. Given the association of 6-month nutritional support with improved anthropometrics and decreased percentage of malnourished patients, our findings indicate that increased awareness of nutritional status and nutritional support is essential for the care of neurologically impaired children with potential benefit of identifying early feeding/swallowing related signs of malnutrition.

PMID: [31365208](#)

15. Longitudinal Development of Receptive Vocabulary in Children with Cerebral Palsy and Anarthria: Use of the MacArthur-Bates CDI.

Molinaro M, Broman AT, Rathouz PJ, Hustad KC.

Dev Neurorehabil. 2019 Jul 29:1-9. doi: 10.1080/17518423.2019.1646829. [Epub ahead of print]

Objective: To examine receptive language growth in children with cerebral palsy (CP) and anarthria using a parent-reported measure of vocabulary. **Method:** Scores from 47 children (29 males) with CP and anarthria were obtained from the vocabulary checklists on the MacArthur-Bates Communication Development Inventories (MCDI) and analyzed to examine the distribution of receptive language growth. Linear trajectories of word composite scores were created using a linear-mixed model, incorporating between two and ten data points per child. **Results:** Three different growth trajectories emerged: approximately 23% grew by 100 or more words per year, 13% grew by 50-100 words per year, and 64% grew by 50 words per year or less. Age-four vocabulary was strongly correlated with rate of increase in vocabulary. **Conclusion:** Receptive vocabulary scores

from the MCDI are increasing at a reduced pace for most children with CP and anarthria. More sensitive measures of language assessment are necessary to gain a complete picture of their language ability levels.

PMID: [31352864](#)

16. Fricative productions of Mandarin-speaking children with cerebral palsy: the case of five-year-olds.

Liu CT, Chen LM, Lin YC, Cheng CY, Lin YC.

Clin Linguist Phon. 2019 Jul 31:1-15. doi: 10.1080/02699206.2019.1636137. [Epub ahead of print]

This study aimed at improving the understanding of speech characteristics of fricatives produced by five-year-old Mandarin-acquiring children with cerebral palsy (CP). Productions from nine CP children and nine gender-and-age-matched typically developing (TD) children were collected and analyzed. Results from transcription indicated that the CP group had lower production accuracy rates for all the five fricatives in Mandarin Chinese. Additionally, when the CP children failed to articulate the target fricative segments, they tended to delete them or convert them into non-continuant segments. Results from acoustic analyses indicated that the M2 values of the labiodental [f] and the M1 and M2 values of the alveolar [s] were higher among the CP children. The experimental results revealed that: (1) Observable differences were available once the age of the groups was properly controlled and acoustical measurements were adopted; (2) the lack of finer-grained speech motor control abilities among CP children were reflected in the M1 and M2 values; (3) for segments at the anterior places, the clinical group failed to extend the articulatory gestures to the desirable positions. It is suggested that future studies focusing on different age groups and children with different native languages would help to approach the nature of articulatory barriers among individuals with CP.

PMID: [31364876](#)

17. Self-reported factors contributing to fatigue and its management in adolescents and adults with cerebral palsy.

Brunton LK, McPhee PG, Gorter JW.

Disabil Rehabil. 2019 Jul 30:1-7. doi: 10.1080/09638288.2019.1647294. [Epub ahead of print]

Purpose: To explore the self-reported factors that generate fatigue and to describe fatigue self-management strategies from the perspectives of adolescents and adults with cerebral palsy (CP). **Materials and methods:** Text responses to open-ended questions of the Fatigue Impact and Severity Self-Assessment from 160 participants (mean age 22.4 years) across all GMFCS levels were coded using inductive line-by-line coding and then grouped together to generate larger categories for each question. Frequency counts associated with each category were then summarized descriptively by Gross Motor Function Classification System level. **Results:** The most commonly reported contributors to fatigue included the following: activity-related factors, general demands of life, sleep/rest, general health concerns, CP-related factors, mental health concerns, and environmental factors. The top five strategies participants reported to manage fatigue included rest or relaxation, sleeping or napping, changing or limiting their activities, being physically active, or using specific adaptations or assistive devices. **Conclusions:** Results from this study suggest that there are potentially modifiable factors, including activity level and sleep, that significantly contribute to fatigue for persons with CP; these could form the basis of interventions targeted at the prevention and management of fatigue. **Implications for Rehabilitation** As individuals with cerebral palsy who are physically active experience significant fatigue, clinicians need to address fatigue to enable these individuals to reap the health benefits of physical activity. Providing education and support to integrate self-management techniques, such as planning and pacing, may be an effective long-term strategy to support individuals to complete highly valued tasks. Interventions targeting modifiable fatigue-generating factors such as activity level, sleep, and mental health concerns are needed.

PMID: [31361159](#)

18. Depression and anxiety in parents of children with intellectual and developmental disabilities: A systematic review and meta-analysis.

Scherer N, Verhey I, Kuper H.

PLoS One. 2019 Jul 30;14(7):e0219888. doi: 10.1371/journal.pone.0219888. eCollection 2019.

INTRODUCTION: Although caring for a child with intellectual and developmental disabilities (IDD) can have positive

outcomes, parents may be at a greater risk of depression and anxiety, due to a number of associated stressors, such as increased caregiver demands and financial strain. This systematic review updates previous data, exploring the relationship between parenting a child with IDD and parental depression and anxiety. **METHODS:** Five electronic databases were searched for eligible English-language articles, published between January 2004 and July 2018. All epidemiological study designs were eligible, provided the level of depression and/or anxiety was compared between parents of children (aged <18) with and without IDD. No limit was placed on geographic location. The proportion of positive associations between parenting a child with IDD and depression/anxiety were disaggregated by disability type, geographic region, and sample size. The percentage of parents at risk of moderate depression or anxiety were calculated using recognised clinical cut-off scores for each screening tool. Meta-analyses, in which pooled effect sizes of elevated depression and anxiety symptoms were calculated, were conducted across two IDD conditions, autism and cerebral palsy. **RESULTS:** Of the 5,839 unique records screened, 19 studies fulfilled the inclusion criteria. The majority of studies were conducted in high-income (n = 8, 42%) or upper-middle income countries (n = 10, 53%). Of the 19 studies, 69% focused on parents of children with cerebral palsy (n = 7, 37%) or autism (n = 6, 32%). Nearly all studies found a positive association between parenting a child with IDD and depression (n = 18, 95%) and anxiety (n = 9, 90%) symptoms. Factors associated with higher levels of depression symptoms amongst parents of children with IDD included disability severity (n = 8, 78%) and lower household income (n = 4, 80%). Approximately one third (31%) of parents of children with IDD reach the clinical cut-off score for moderate depression, compared with 7% of parents of children without IDD. 31% of parents of children with IDD reach the cut-off score for moderate anxiety, compared with 14% of parents of children without IDD. The meta-analyses demonstrated moderate effect sizes for elevated depression amongst parents of children with autism and cerebral palsy. **CONCLUSIONS:** Results indicate elevated levels of depressive symptoms amongst parents of children with IDD. Quality concerns amongst the existing literature support the need for further research, especially in low- and middle-income countries.

PMID: [31361768](#)

19. Update on the current management of newborns with neonatal encephalopathy.

Wachtel EV, Verma S, Mally PV.

Curr Probl Pediatr Adolesc Health Care. 2019 Jul 29;100636. doi: 10.1016/j.cppeds.2019.07.001. [Epub ahead of print]

Hypoxic-ischemic encephalopathy is a subtype of neonatal encephalopathy and a major contributor to global neonatal morbidity and mortality. Despite advances in obstetric and neonatal care there are still challenges in accurate determination of etiology of neonatal encephalopathy. Thus, identification of intrapartum risk factors and comprehensive evaluation of the neonate is important to determine the etiology and severity of neonatal encephalopathy. In developed countries, therapeutic hypothermia as a standard of care therapy for neonates with hypoxic-ischemic encephalopathy has proven to decrease incidence of death and neurodevelopmental disabilities, including cerebral palsy in surviving children. Advances in neuroimaging, brain monitoring modalities, and biomarkers of brain injury have improved the ability to diagnose, monitor, and treat newborns with encephalopathy. However, challenges remain in early identification of neonates at risk for hypoxic-ischemic brain injury, and determination of the timing and extent of brain injury. Using imaging studies such as Neonatal MRI and MR spectroscopy have proven to be most useful in predicting outcomes in infants with encephalopathy within the first week of life, although comprehensive neurodevelopmental assessments still remains the gold standard for determining long term outcomes. Future studies are needed to identify other newborns with encephalopathy that might benefit from therapeutic hypothermia and to determine the efficacy of other adjunctive neuroprotective strategies. This review focuses on newer evidence and advances in diagnoses and management of infants with neonatal encephalopathy, including novel therapies, as well as prognostication of outcomes to childhood.

PMID: [31371100](#)

20. The impact of neonatal posthemorrhagic hydrocephalus of prematurity on family function at preschool age.

Agajany N, Gigi M, Ross J, Roth J, Eshel R, Constantini S, Bassan H.

Early Hum Dev. 2019 Jul 30;137:104827. doi: 10.1016/j.earlhumdev.2019.104827. [Epub ahead of print]

AIMS: To determine the impact on families (IOF) of former preterm infants (gestational age < 32 weeks) after posthemorrhagic hydrocephalus requiring shunt (PHH-S), and to identify risk factors of family dysfunction. **STUDY DESIGN:** 38 preterm infants with PHH-S were matched for gestational age, birthweight, and gender with preterm infants with normal cranial ultrasonography. IOF questionnaire was administered at 5.7 ± 2 years (higher IOF score indicates worse impact). **RESULTS:** Families of PHH-S children exhibited significantly worse IOF compared to controls in financial (9.2 ± 2.2 vs 5.9 ± 1.4), family-personal (26.6 ± 5.2 vs 20.2 ± 2.8), and disruptive social (21.4 ± 4.9 vs 16.7 ± 3.1) domains (P < 0.001). Multivariate regression incorporating neonatal risk factors revealed an independent effect of parenchymal brain involvement (β:0.4, P:0.002) and

neonatal seizures (β :0.3, p :0.007) on total IOF. Neurosensory morbidity was significantly higher in the PHH-S group, including cerebral palsy (81.6%), epilepsy (47.4%), problems with vision (63.2%), feeding (39.5%) and hearing (18.4%), chronic health problems (44.7%) and hospital admissions in the last 6 months (44.7%). Worse IOF scores of PHH-S families were associated with socioeconomic status and neurodevelopmental morbidities: cerebral palsy severity, feeding problems, number of neurosurgeries, low cognitive, personal-social, and adaptive scores ($P < 0.05$). Multivariate analysis indicated an independent contribution from cerebral palsy severity (β :0.5, p :0.002) and socioeconomic status (β :-0.4, P : 0.01). **CONCLUSIONS:** Families of preterm children after PHH-S exhibit significantly worse IOF scores compared to families of preterm peers. Worse IOF is associated with severe hemorrhage, neurodevelopmental morbidities and socioeconomic status. A family centered intervention is warranted after PHH-S.

PMID: [31374456](#)

21. Neurite orientation dispersion and density imaging quantifies corticospinal tract microstructural organization in children with unilateral cerebral palsy.

Nemanich ST, Mueller BA, Gillick BT.

Hum Brain Mapp. 2019 Jul 29. doi: 10.1002/hbm.24744. [Epub ahead of print]

Children with unilateral cerebral palsy (UCP) due to early brain injury exhibit disrupted connectivity of corticospinal tracts (CSTs), which can be quantified using diffusion-weighted magnetic resonance imaging (DWI). Diffusion tensor imaging (DTI) is commonly used to quantify white matter organization, however, this model lacks the biological specificity to accurately describe underlying microstructural properties. Newer approaches, such as neurite orientation dispersion and density imaging (NODDI), may provide more biologically accurate information regarding CST microstructure. In this study, we directly compared metrics of CST microstructure using NODDI and DTI models to characterize the microstructural organization of corticospinal pathways. Twenty participants with UCP participating in a neuromodulation/rehabilitation intervention underwent imaging including multi-shell DWI; 10 participants' datasets were adequately completed for neuroimaging analysis. Task fMRI-guided probabilistic tractography from motor cortex to brainstem was performed at baseline and follow-up to reconstruct the CSTs. Diffusion metrics were compared between hemispheres at baseline, and between baseline and follow-up to test for intervention effects. Correlation analyses were used to compare baseline metrics to changes in hand function following the intervention. DTI results showed that mean fractional anisotropy in lesioned and nonlesioned CSTs did not significantly differ, but mean, axial, and radial diffusivity were greater in the lesioned CST. For NODDI, intracellular volume fraction (ICVF) and orientation dispersion index (ODI) were lower in the lesioned CST. Unimanual function was strongly correlated with ICVF, but not FA. NODDI may reveal distinct properties of CST microstructure that are linked to motor function, indicating their potential in characterizing brain structure and development.

PMID: [31355991](#)

22. Corpus callosum agenesis with interhemispheric cyst: a neuroimage to remember.

Reddy C, Bhattacharya D, Madaan P, Saini L.

BMJ Case Rep. 2019 Jul 24;12(7). pii: e231375. doi: 10.1136/bcr-2019-231375.

PMID: [31345835](#)