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Interventions and Management

1. Exploring relevant parameters and investigating their reproducibility of task-oriented unimanual strength measurement in children with unilateral cerebral palsy

Mellanie Geijen, Caroline Bastiaenen, Andrew Gordon, Rob Smeets, Eugene Rameckers

Disabil Rehabil. 2023 Feb 16;1-7. doi: 10.1080/09638288.2023.2178677. Online ahead of print.

Purpose: To explore relevant parameters and investigate their test-retest reliability within the scope of the push button task of the Task-oriented Arm-hAnd Capacity (TAAC) measured in children with unilateral Cerebral Palsy (CP). **Methods:** 118 children diagnosed with unilateral CP, aged between 6 and 18 years, participated in this study. The test-retest reliability of the force generated during the push button task of the TAAC was investigated using an intraclass correlation (ICC) two-way random model with absolute agreement. The ICCs were calculated across the whole age group and for two separate age subgroups (6-12 and 13-18 years). **Results:** Test-retest reliability of the parameters "mean peak force of all attempts", "overshoot of force", "number of successful attempts" and "time to complete four successful attempts" were moderate to good (ICC range 0.667-0.865; 0.721-0.908; 0.733-0.817, respectively). **Conclusions:** The results showed moderate to good test-retest reliability for all parameters. The parameters "mean peak force" and "number of successful attempts" are the most relevant parameters, as these parameters are task-specific and the most functional for clinical practice. **Implications for Rehabilitation:** Clinical relevant information about the use of task-oriented strength during the performance of daily activity has been added to strength measurements in children with Cerebral Palsy. The Task-oriented Arm-hAnd Capacity instrument is a reliable, objective and simple instrument to measure task-oriented strength during daily activity and is ready for use in a clinical setting. The Task-oriented Arm-hAnd Capacity instrument is both a capacity and performance-based test. The measurement with the push button task showed moderate to good test-retest reliability.

PMID: [36794727](https://pubmed.ncbi.nlm.nih.gov/36794727/)

2. Can wrist-worn devices and a smartphone application influence arm activity in children with unilateral cerebral palsy? A proof-of-concept study

Amie Turner, Dan Jackson, Eleanor Officer, Chelsy Boyne-Nelson, Zosia Zielinska, Divya Dinraj, Jessica Blickwedel, Tom Nappey, Tim Rapley, Heather Turpin, Jill Cadwgan, Janice Elizabeth Pearse, Anna Purna Basu

Front Rehabil Sci. 2023 Jan 30;3:1060191. doi: 10.3389/fresc.2022.1060191. eCollection 2022.

Aim: To determine whether a wrist-worn triaxial accelerometer-based device and software (including smartphone application), incorporating feedback, is feasible, acceptable, and can lead to increased affected upper limb use during everyday activities in children with unilateral cerebral palsy (UCP). **Methods:** Study design: Mixed methods proof of concept study. **Participants:** Children aged 8-18 years with UCP; age-matched typically developing controls ("Buddies"), therapists.

Intervention: Baseline (2 weeks): devices recorded arm activity. Active feedback (6 weeks): devices also gave vibratory prompts if affected arm activity fell below pre-set personalised thresholds (UCP group only; control group continued as per Baseline). Final 2 weeks: as baseline. Both groups accessed a smartphone application providing feedback on relative arm motion throughout the study. Assessment and analysis: ABILHAND-Kids questionnaires and MACS classifications captured baseline participant characteristics (UCP group). Accelerometer data was used to calculate relative arm activity (signal vector magnitude) corrected for time worn/day, and trends in relative arm activity examined using single case experimental design (both groups). In-depth interviews with families, "Buddies" and therapists assessed feasibility and acceptability of implementation. A framework approach was used for qualitative data analysis. Results: We recruited 19 participants with UCP; 19 buddies; and 7 therapists. Five participants (two with UCP) did not complete the study. Baseline mean (stdev) ABILHAND-Kids score of children with UCP who completed the study was 65.7 (16.2); modal MACS score was II. Qualitative analysis demonstrated acceptability and feasibility of the approach. Active therapist input for this group was minimal. Therapists appreciated the potential for summary patient data to inform management. Arm activity in children with UCP increased in the hour following a prompt (mean effect size $z = 0.261$) for the non-dominant hand, and the dominant hand ($z = 0.247$). However, a significant increase in affected arm activity between baseline and intervention periods was not demonstrated. Discussion: Children with UCP were prepared to wear the wristband devices for prolonged periods. Whilst arm activity increased bilaterally in the hour following a prompt, increases were not sustained. Delivery of the study during the COVID-19 pandemic may have negatively influenced findings. Technological challenges occurred but could be overcome. Future testing should incorporate structured therapy input.

PMID: [36794268](#)

3. Reliability and Discriminative Validity of Wearable Sensors for the Quantification of Upper Limb Movement Disorders in Individuals with Dyskinetic Cerebral Palsy

Inti Vanmechelen, Saranda Bektishi, Helga Haberfehlner, Hilde Feys, Kaat Desloovere, Jean-Marie Aerts, Elegast Monbaliu

Sensors (Basel). 2023 Feb 1;23(3):1574. doi: 10.3390/s23031574.

Background-Movement patterns in dyskinetic cerebral palsy (DCP) are characterized by abnormal postures and involuntary movements. Current evaluation tools in DCP are subjective and time-consuming. Sensors could yield objective information on pathological patterns in DCP, but their reliability has not yet been evaluated. The objectives of this study were to evaluate (i) reliability and (ii) discriminative ability of sensor parameters. Methods-Inertial measurement units were placed on the arm, forearm, and hand of individuals with and without DCP while performing reach-forward, reach-and-grasp-vertical, and reach-sideways tasks. Intra-class correlation coefficients (ICC) were calculated for reliability, and Mann-Whitney U-tests for between-group differences. Results-Twenty-two extremities of individuals with DCP (mean age 16.7 y) and twenty individuals without DCP (mean age 17.2 y) were evaluated. ICC values for all sensor parameters except jerk and sample entropy ranged from 0.50 to 0.98 during reach forwards/sideways and from 0.40 to 0.95 during reach-and-grasp vertical. Jerk and maximal acceleration/angular velocity were significantly higher for the DCP group in comparison with peers. Conclusions-This study was the first to assess the reliability of sensor parameters in individuals with DCP, reporting high between- and within-session reliability for the majority of the sensor parameters. These findings suggest that pathological movements of individuals with DCP can be reliably captured using a selection of sensor parameters.

PMID: [36772614](#)

4. Spinal cord H-reflex post-activation depression is linked with hand motor control in adults with cerebral palsy

Shekar S Dukkipati, Sarah J Walker, Michael P Trevarrow, Morgan T Busboom, Max J Kurz

Clin Neurophysiol. 2023 Jan 25;148:9-16. doi: 10.1016/j.clinph.2023.01.004. Online ahead of print.

Objective: Cerebral palsy (CP) is associated with upper extremity motor impairments that are largely assumed to arise from alterations in the supraspinal networks. The objective of this study was to determine if post-activation depression of the spinal H-reflexes is altered in adults with CP and connected with altered upper extremity function. Methods: The post-activation depression of the flexor carpi radialis (FCR) H-reflex of adults with CP and healthy adults (HA) controls were assessed by 1) a 1 Hz continuous single-pulse stimulus train and 2) 0.11 Hz / 1 Hz paired-pulse stimuli. Secondly, we measured the maximum key grip force and the box and blocks assessment of manual dexterity. Results: Our results revealed that adults with CP had reduced post-activation depression of the FCR H-reflex during the stimulus train and the paired pulse protocol. A greater reduction in H-reflex post-activation depression was connected to lower manual dexterity and weaker grip forces.

Conclusions: Our results indicate that the post-activation depression of the upper extremity spinal H-reflex pathways is altered in adults with CP and possibly linked with their uncharacteristic upper extremity motor performance. Alterations in the spinal networks may also play a significant role in the altered motor control of adults with CP. Significance: Our results identify spinal H-reflex modulation as a possible locus for hand motor control in CP.

PMID: [36773504](#)

5. Use of Growth Rod Systems for Management of Early Onset Scoliosis in Cerebral Palsy: A Systematic Review Kshitij Gupta, Sitanshu Barik, Mosharaf Sarkar, Sunny Chaudhary, Sourabh Sinha, Vikash Raj, Pankaj Kandwal

Turk Neurosurg. 2022 Nov 29. doi: 10.5137/1019-5149.JTN.41939-22.2. Online ahead of print.

Aim Cerebral palsy is frequently associated with neuromuscular scoliosis with larger curves requiring surgical intervention. The aim of this study was to assess the literature for the role and outcome of growing rod surgeries in these patients. Methods A systematic search was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Electronic literature search was conducted of PubMed and Embase databases. Patient demographics, type of growing rod used, lengthening and complications were analyzed from the included studies. Results A total of 11 studies with poor overall study quality (Level of evidence IV, V) were included in the study. A total of 181 patients with mean age 6.8 ± 1.3 (5-13 range) years at index surgery and mean follow-up of 3.02 ± 1.3 (2-5.8 range) years were included in the study, with a female preponderance. The most common curve and instrumentation was thoraco-lumbar and conventional dual growing rods respectively. All studies showed improvement in Cobb's angle and pelvic obliquity. There was better improvement in pelvic obliquity if pelvis was included in instrumentation. Wound related complications (34.6%) were most commonly noted. Conclusion Overall growing rod construct has shown questionable outcomes in cerebral palsy patients with scoliosis in terms of the complication rate observed although allowing growth of the spinal column with regular lengthenings. Magnetic controlled growth rods hold a bright promise for the future considering its ability to maintain correction as well as the lower rate of complications The benefits and risk of immediate fusion with respect to growth sparing surgeries should be considered before the decision.

PMID: [36799279](#)

6. Hip Surgery in Cerebral Palsy: A Bibliometric Analysis Norine Ma, Nicholas Sclavos, Kerr Graham, Erich Rutz

Review Int J Environ Res Public Health. 2023 Jan 18;20(3):1744. doi: 10.3390/ijerph20031744.

Hip dislocation in cerebral palsy can lead to pain, pressure sores and difficulty with perineal hygiene. Hip surveillance programs have been implemented to identify patients who might benefit from early intervention and preventive strategies. Surgical techniques used to treat hip dislocation include soft tissue procedures, guided growth, osteotomies and salvage procedures. A search was conducted using Clarivate Web of Science Core Collection on 18 October 2022, to identify all studies of bony or soft tissue surgery for hip pathology in children with cerebral palsy. Fifty-nine original studies and reviews with at least 20 citations were included in this bibliometric analysis. We found that there has been an increase in studies over the decades, with the most studies being published in the Journal of Pediatric Orthopaedics. The United States of America was the most productive country, with Boston Children's Hospital and Harvard University publishing the most articles. The Methodological Index for Non-randomized Studies (MINORS) scoring system was used to analyse the methodological quality of included cohort studies, with the median score being 11 out of 18; many studies had no prospective calculation of study size and lacked control groups. Overall, the literature on this topic appears to be preferentially published in the Journal of Pediatric Orthopaedics, and influential papers by Hagglund 2005 and 2014 continue to be highly cited.

PMID: [36767108](#)

7. Effects of ankle-foot orthoses on different gait patterns in children with spastic cerebral palsy: A statistical parametric mapping study

Florian Dobler, Johannes Cip, Harald Lengnick, Nathalie Alexander

Prosthet Orthot Int. 2023 Feb 13. doi: 10.1097/PXR.0000000000000216. Online ahead of print.

Background: Ankle-foot orthoses (AFOs) are a common treatment to correct gait deviations in children with spastic cerebral palsy (SCP). Studies on the outcome of AFOs on gait often do not account for different gait patterns. **Objectives:** The aim of this study was to investigate the effects of AFOs on specific gait patterns in children with cerebral palsy. **Study design:** Retrospective, unblinded, controlled, cross-over study. **Methods:** Twenty-seven children with SCP were assessed in the conditions walking barefoot or with shoes and AFO. AFOs were prescribed based on usual clinical practice. Gait patterns for each leg were classified as excess ankle plantarflexion in stance (equinus), excess knee extension in stance (hyperextension), or excess knee flexion in stance (crouch). Differences in spatial-temporal variables and sagittal kinematics and kinetics of the hip, knee, and ankle between the 2 conditions were determined using paired t-tests and statistical parametric mapping, respectively. The effect of AFO-footwear neutral angle on knee flexion was tested using statistical parametric mapping regression. **Results:** AFO use improved spatial-temporal variables and reduced ankle power generation in preswing. For "equinus" and "hyperextension" gait patterns, AFOs decreased ankle plantarflexion in preswing and initial swing and decreased ankle power in preswing. Ankle dorsiflexion moment increased in all gait pattern groups. Knee and hip variables did not change in any of the 3 groups. AFO-footwear neutral angle had no effect on changes in sagittal knee angle. **Conclusion:** Although improvements in spatial-temporal variables were seen, gait deviations could only partially be corrected. Therefore, AFO prescriptions and design should individually address specific gait deviations and their effectiveness in children with SCP should be controlled.

PMID: [36795944](#)

8. Muscle Activity and Co-Activation of Gait Cycle during Walking in Water and on Land in People with Spastic Cerebral Palsy

Pariyaporn Phothisrook, Sugalya Amatachaya, Punnee Peungsuwan

Int J Environ Res Public Health. 2023 Jan 19;20(3):1854. doi: 10.3390/ijerph20031854.

Background: The purpose of this study was to investigate the differences in the muscle activity and co-activation index (CoA) of the rectus femoris (RF), biceps femoris (BF), gastrocnemius medialis (GM,) and tibialis anterior (TA) during walking on land and in water in healthy adolescents compared with those with spastic diplegia cerebral palsy (CP) adolescents. **Methods:** Four healthy individuals (median; age: 14 years, height: 1.57 cm, BMI: 16.58 kg/m²) and nine CP individuals (median; age: 15 years, height: 1.42 cm, BMI: 17.82 kg/m²) participated in this study and performed three walking trials under both conditions. An electromyography (EMG) collection was recorded with a wireless system Cometa miniwave infinity waterproof device, and the signals were collected using customized software named EMG and Motion Tools, Inc. software version 7 (Cometa slr, Milan, Italy) and was synchronized with an underwater VDO camera. **Results:** A significant decrease in the muscle activity of all muscles and CoA of RF/BF muscles, but an increase in TA/GM was observed within the CP group while walking in water during the stance phase. Between groups, there was a lower CoA of RF/BF and a greater CoA of TA/GM during the stance phase while walking in water and on land in the CP group. A non-significant difference was observed within the healthy group. **Conclusion:** Walking in water can decrease muscle activity in lower limbs and co-activation of thigh muscles in people with spastic CP, whereas CoA muscles around ankle joints increased to stabilize foot weight acceptance.

PMID: [36767224](#)

9. Combining intensive rehabilitation with a non-functional isokinetic strengthening program in adolescents with cerebral palsy: a study protocol for a randomized controlled trial

Mathias Guérin, Benoit Sijobert, Benjamin Zaragoza, Flore Cambon, Laurence Boyer, Karine Patte

JMIR Res Protoc. 2022 Dec 28. doi: 10.2196/43221. Online ahead of print.

Background: Cerebral palsy (CP) is the most common brain injury in the pediatric population. CP patients present different affectations such as decreased muscle strength, gait deviations, impaired proprioception, and spasticity. Isokinetic

strengthening programs combined with an intensive rehabilitation may improve muscle strength and therefore gait efficiency. Clinical Trials: The protocol has been accepted by the French National Ethics Committee (IDRCB: 2022-A00431-42). Objective: The primary aim of this randomized controlled trial is to compare the effect of an intensive rehabilitation combined with a non-functional isokinetic progressive strengthening program to an intensive rehabilitation alone on gait parameters and muscle strength in CP patients. Another goal of the current study is to determine whether adding an isokinetic program to an intensive rehabilitation is more effective than an intensive rehabilitation alone on decreasing spasticity and improving joint position sense in CP patients. Methods: Thirty adolescents with spastic diplegia CP (GMFCS level I to III) will be randomized, by an independent researcher, into a 3-week intensive rehabilitation and isokinetic progressive strengthening group or an intensive rehabilitation control group. Gait parameters, muscle strength, spasticity and knee joint position sense will be assessed. These variables will be evaluated at baseline (T0) and at the end of the intervention (T1). The intensive rehabilitation will consist of physiotherapy sessions twice a day and hydro-therapy and virtual reality gait training once a day. The isokinetic training group will have a total of 9 supervised isokinetic strength training focusing on knee flexors and extensors with different execution speeds. Results: The protocol has been accepted by the French National Ethics Committee in October 2022. Inclusion of patients will start in November 2022. Conclusions: The combination of an intensive rehabilitation with an isokinetic program on knee flexors and extensors have not been studied yet. The findings of this study may determine if an isokinetic strength training program of knee flexors and extensors is beneficial to improve gait parameters, muscle strength, spasticity, and joint position sense in adolescents with spastic diplegia. Clinical trial: The protocol has been accepted by the French National Ethics Committee (IDRCB: 2022-A00431-42).

PMID: [36790338](#)

10. The 'heROIC' Trial: Does the use of a Robotic rehabilitation trainer change Quality Of Life, range of movement and function In children with Cerebral Palsy?

Clare Grodon, Paul Bassett, Harriet Shannon

Child Care Health Dev. 2023 Feb 14. doi: 10.1111/cch.13101. Online ahead of print.

Background: Children with severe cerebral palsy (CP) (GMFCS IV/V) can find it difficult to access equipment that allows them to exercise effectively, potentially impacting their quality of life. Physiotherapists working within special schools are well placed to facilitate increased physical activity as part of the school day. This study explored whether the Innowalk Pro, a robotic rehabilitation trainer, could influence quality of life (measured by the CPCHILD questionnaire), in children with CP, alongside, joint range of movement, spasticity and functional goals of the lower limbs, measured by goniometry, modified Tardieu scale and goal attainment scoring, GAS, respectively. Methods: A prospective single-arm, pre-post trial was undertaken. The Innowalk Pro was used four times a week for 30 minutes alongside usual physiotherapy care in a school setting over a six-week period. Outcomes were evaluated immediately pre/post intervention and at six-weeks and three-months post intervention. Analysis also explored differences between primary and secondary age participants. Results: Twenty-seven participants aged 5-18 years with a diagnosis of CP GMFCS IV/V (10 female, 17 male, mean age 12 years) were included from a convenience sample in a special school. Quality of life improved in 36% of participants, the majority of these being secondary aged. Knee extension reduced significantly three-months post intervention. There were no meaningful changes in spasticity. GAS goals improved in 88% of participants after using the Innowalk Pro. GAS goals tended to decline after a break from using the equipment, with 21% declining by two or more units at three-months post intervention. Conclusion: A six-week course of the Innowalk Pro can improve quality of life and functional goals for children with CP aged 5-18 years. After a break of 6-12 weeks, functional goals tend to return to baseline. Further research is needed to explore different prescriptions of the Innowalk Pro, to see if increasing the time used/increasing the frequency or number of weeks it is used for can provide longer lasting benefits.

PMID: [36788457](#)

11. Longitudinal change in speech classification between 4 and 10 years in children with cerebral palsy

No authors listed

Dev Med Child Neurol. 2023 Feb 14. doi: 10.1111/dmcn.15549. Online ahead of print.

No abstract available

PMID: [36786015](#)

12. Optical spectral diagnostics of the oxygenation level in periodontal tissues and photodynamic therapy using methylene blue in children with cerebral palsy

Natalia S Morozova, Iuliia A Kozlitina, Vladimir I Makarov, Victor B Loschenov, Vasilii M Grinin, Sergey Yu Ivanov, Maria S Kashtanova

Front Public Health. 2023 Jan 30;11:961066. doi: 10.3389/fpubh.2023.961066. eCollection 2023.

Dental diseases occur in children with cerebral palsy three times higher than in healthy children. Low values of the unstimulated salivation rate (<0.3 ml per minute), pH and buffer capacity, changes in enzyme activity and sialic acid concentration, as well as increased saliva osmolarity and total protein concentration, which indicates impaired hydration, are the factors in the development of a gingiva disease in case of cerebral palsy. This leads to increased bacterial agglutination and the formation of acquired pellicle and biofilm, leading to the formation of dental plaque. There is a tendency toward an increase in the concentration of hemoglobin and a decrease in the degree of hemoglobin oxygenation, as well as an increase in the generation of reactive oxygen and nitrogen species. Photodynamic therapy (PDT) with the use of photosensitizer methylene blue improves blood circulation and the degree of oxygenation in periodontal tissues, as well as eliminates a bacterial biofilm. Analysis of back diffuse reflection spectra makes it possible to conduct non-invasive monitoring determine tissue areas with a low level of hemoglobin oxygenation for precision photodynamic exposure. Aim: To improve the effectiveness of phototheranostics methods using, namely PDT with simultaneous optical-spectral control, for the treatment of gingivitis in children with complex dental and somatic status (cerebral palsy). Methods: The study involved 15 children (6-18 y.o.) with various forms of cerebral palsy, in particular, spastic diplegia and atonic-astatic form and with gingivitis. The degree of hemoglobin oxygenation was measured in tissues before PDT and on the 12th day. PDT was performed using laser radiation ($\lambda = 660$ nm) with a power density of 150 mW/cm² with a five-minute application of 0.01% MB. The total light dose was 45 ± 15 J/cm². For statistical evaluation of the results, a paired Student's t-test was used. Results: The paper presents the results of phototheranostics using methylene blue in children with cerebral palsy. An increase in the level of hemoglobin oxygenation from 50 to 67% ($p < 0.001$) and a decrease in blood volume in the microcirculatory bed of periodontal tissues were shown. Conclusion: Photodynamic therapy methods with application of methylene blue make it possible to assess the state of the gingival mucosa tissue diseases objectively in real time, and to provide effective targeted therapy for gingivitis in children with cerebral palsy. There is a prospect that they can become widely used clinical methods.

PMID: [36794072](#)

13. Prophylactic antireflux procedures are not necessary in neurologically impaired children undergoing gastrostomy placement

Michael D Williams, Nicholas Skertich, Gwyneth A Sullivan, Kelly Harmon, Mary Beth Madonna, Srikumar Pillai, Ami N Shah, Brian C Gulack

Pediatr Surg Int. 2023 Feb 14;39(1):122. doi: 10.1007/s00383-023-05398-x.

Purpose: Fundoplication is frequently used in children with neurologic impairment even in the absence of reflux due to concerns for future gastric feeding intolerance, but supporting data are lacking. We aimed to determine the incidence of secondary antireflux procedures (fundoplication or gastrojejunostomy (GJ)) post gastrostomy tube (GT) placement in children with and without neurologic impairment. Methods: Children under 18 undergoing a GT placement without fundoplication between 2010 and 2020 were identified utilizing the PearlDiver Mariner national patient claims database. Children with a diagnosis of cerebral palsy or a degenerative neurologic disease were identified and compared to children without these diagnoses. The incidence of delayed fundoplication or conversion to GJ were compared utilizing Kaplan-Meier and Cox proportional hazards regression analyses. Results: A total of 14,965 children underwent GT placement, of which 3712 (24.8%) had a diagnosis of neurologic impairment. The rate of concomitant fundoplication was significantly higher among children with a diagnosis of neurologic impairment as compared to those without (9.3% vs 6.4%, $p < 0.001$). While children with neurologic impairment had a significantly higher rate of fundoplication or GJ conversion at 5 years compared to children without (12.6% [95% confidence interval (CI): 11.4%-13.8%] vs 8.6% [95% CI 8.0%-9.2%], $p < 0.001$), the overall incidence remained low. Conclusion: Although children with neurologic impairment have a higher rate of requiring an antireflux procedure or GJ conversion than other children, the overall rate remains less than 15%. Fundoplication should not be utilized in children without clinical reflux on the basis of neurologic impairment alone.

PMID: [36786900](#)

14. User-perceived impact of long-term mechanical assisted cough in paediatric neurodisability

Brit Hov, Tiina Andersen, Michel Toussaint, Ingvild B Mikalsen, Maria Vollsaeter, Heidi Markussen, Solfrid Indrekvam, Vegard Hovland

Dev Med Child Neurol. 2023 Feb 14. doi: 10.1111/dmcn.15543. Online ahead of print.

Aim: To (1) compare the perceived benefit of long-term mechanical insufflation-exsufflation (MI-E) of children with neuromuscular disorders (NMDs) and central nervous system (CNS) disorders, including health care needs and treatment routines and (2) describe the children's health-related quality of life (HRQoL). **Method:** This cross-sectional study used a questionnaire and memory card data to assess the perceived benefit of MI-E via the Visual Analogue Scale (VAS; 10 maximum), willingness to pause treatment, level of health care needs before and after MI-E initiation, and the children's treatment routines. A DISABKIDS questionnaire assessed HRQoL (100 maximum). **Results:** Seventy-three children using MI-E participated (42 males, median [interquartile range {IQR}] age 10 years 2 months [6 years 3 months-14 years 1 month]), 47 with NMDs (such as spinal muscular atrophy and Duchenne muscular dystrophy) and 26 with CNS disorders (such as cerebral palsy, encephalitis, neurometabolic and other diseases). The median (IQR) VAS score for the perceived benefit of MI-E therapy at stable state and respiratory tract infection were 9 (6-10) and 10 (8.5-10) respectively. Sixty-two per cent were reluctant or unwilling to pause MI-E therapy, with no NMD versus CNS disorder group difference. After MI-E initiation, fewer physician consultations and hospitalizations were reported by the group with NMDs. The MI-E routine was similar in both groups. The mean (SD) HRQoL score for 26 of 51 eligible children was 71 (16.7). **Interpretation:** MI-E treatment was generally perceived as beneficial and performed equally in both diagnostic groups. HRQoL was in line with children with a moderate-to-severe chronic condition.

PMID: [36787316](#)

15. Youth with Cerebral Palsy Display Abnormal Somatosensory Cortical Activity during a Haptic Exploration Task

Michael P Trevarrow, Hannah E Bergwell, Boman R Groff, Alex I Wiesman, Tony W Wilson, Max J Kurz

Neuroscience. 2023 Feb 14;S0306-4522(23)00053-2. doi: 10.1016/j.neuroscience.2023.01.030. Online ahead of print.

There are numerous clinical reports that youth with cerebral palsy (CP) have proprioceptive, stereognosis and tactile discrimination deficits. The growing consensus is that the altered perceptions in this population are attributable to aberrant somatosensory cortical activity seen during stimulus processing. It has been inferred from these results that youth with CP likely do not adequately process ongoing sensory feedback during motor performance. However, this conjecture has not been tested. Herein, we address this knowledge gap using magnetoencephalographic (MEG) brain imaging by applying electrical stimulation to the median nerve of youth with CP (N=15, Age = 15.8 ± 0.83 yrs, Males = 12, MACS levels I-III) and neurotypical (NT) controls (N=18, Age = 14.1 ± 2.4 yrs, Males = 9) while at rest (i.e., passive) and during a haptic exploration task. The results illustrated that somatosensory cortical activity was reduced in the group with CP compared to controls during the passive and haptic conditions. Furthermore, the strength of the somatosensory cortical responses during the passive condition were positively associated with the strength of somatosensory cortical responses during the haptic condition ($r = 0.75$, $P = 0.004$). This indicates that the aberrant somatosensory cortical responses seen in youth with CP during rest are a good predictor of the extent of somatosensory cortical dysfunction during the performance of motor actions. These data provide novel evidence that aberrations in somatosensory cortical function in youth with CP likely contribute to the difficulties in sensorimotor integration and the ability to effectively plan and execute motor actions.

PMID: [36796750](#)

16. Pain trajectories and well-being in children and young people with cerebral palsy: A cohort study

No authors listed

Dev Med Child Neurol. 2023 Feb 12. doi: 10.1111/dmcn.15548. Online ahead of print

No abstract available

PMID: [36775816](#)

17. Menstrual health and genital hygiene status in adolescent girls and young women with cerebral palsy

Duygu Türker, Hanife Doğan, Ozge Coban, Merve Basol Goksuluk, Nuriye Özengin, Necmiye Ün Yıldırım

Health. 2023 Feb 12;1-8. doi: 10.1080/03630242.2023.2171175. Online ahead of print.

Menstrual health and genital hygiene behavior in patients with cerebral palsy (CP) is underrecognized, undertreated, and negatively affects quality of life. The aim of this case-control study is to compare menstrual health and genital hygiene behaviors in adolescent girls and young women with CP to a healthy women control group. Participants were invited to study via social media tools between August 2021 and February 2022. The study included 74 adolescent girls and young women with CP and 89 healthy women. Menstrual status with semi-structured questions, menstrual symptoms with "Menstrual Symptom Questionnaire (MSQ)," genital hygiene behavior with "Genital Hygiene Behavior Scale (GHBS)" were evaluated. The control group scored significantly higher on the MSQ sub-dimensions of "negative effects somatic complaints" ($r = 0.396$; $p < .001$), "menstrual pain" ($r = 0.287$; $p < .001$), "coping methods" ($r = 0.291$; $p < .001$), and total score ($r = 0.395$; $p < .001$), as well as the GHBS sub-dimensions of "awareness of abnormal findings" ($r = 0.270$; $p = .001$) and "menstrual hygiene" ($r = 0.495$; $p < .001$) and total score ($r = 0.393$; $p < .001$). People with CP had worse genital hygiene behavior, had less menstrual symptoms, and behaved differently about the menstruation symptoms. This study focused on adolescent girls and young women with CP who cannot easily express their own experiences and concerns, emphasized that their needs should be identified by determining their menstrual health and genital hygiene behaviors. Clinical Registration Name, Registration Number, Registration Date: Menstrual Health and Genital Hygiene Status in Cerebral Palsy and NCT04985045, August 2, 2021.

PMID: [36775296](#)**18. Review of Machine Learning and Artificial Intelligence (ML/AI) for the Pediatric Neurologist**

Grace Y Gombolay, Nakul Gopalan, Andrea Bernasconi, Rima Nabbout, Jonathan T Megerian, Benjamin Siegel, Jamika Hallman-Cooper, Sonam Bhalla, Matthew C Gombolay

Review Pediatr Neurol. 2023 Jan 13;141:42-51. doi: 10.1016/j.pediatrneurol.2023.01.004. Online ahead of print.

Artificial intelligence (AI) and a popular branch of AI known as machine learning (ML) are increasingly being utilized in medicine and to inform medical research. This review provides an overview of AI and ML (AI/ML), including definitions of common terms. We discuss the history of AI and provide instances of how AI/ML can be applied to pediatric neurology. Examples include imaging in neuro-oncology, autism diagnosis, diagnosis from charts, epilepsy, cerebral palsy, and neonatal neurology. Topics such as supervised learning, unsupervised learning, and reinforcement learning are discussed.

PMID: [36773406](#)**19. Risk factors for perinatal stroke in term infants: A case-control study in Australia**

Bithi Roy, Annabel Webb, Karen Walker, Catherine Morgan, Nadia Badawi, Iona Novak

J Paediatr Child Health. 2023 Feb 14. doi: 10.1111/jpc.16372. Online ahead of print.

Aim: The aetiology of perinatal stroke is poorly understood. This study aimed to prospectively confirm the risk factors and identify any previously unknown variables. Methods: A prospective case-control study was conducted in Australia. Univariate odds ratios (ORs), associated 95% confidence intervals (CIs) and multivariable logistic regression models fitted with backwards stepwise variable selection were used. Results: Sixty perinatal stroke cases reported between 2017 and 2019 included 95% (57/60) with multiple risk factors. Univariate analysis identified emergency caesarean section rather than NVD ($P < 0.01$), low Apgar score (<7) at 1, 5 and 10 min of age ($P < 0.01$), resuscitation at birth ($P < 0.01$), abnormal cord blood gas ($P < 0.01$), neonatal infection/sepsis ($P < 0.01$), congenital heart disease ($P < 0.01$) and hypoglycaemia ($P < 0.01$) as significant risk factors. Multivariate analysis found smoking during pregnancy (OR: 1.48; 95% CI: 1.09-1.99), 1-min Apgar score < 7 (OR: 1.54; 95% CI: 1.15-2.08), 10-min Apgar score < 7 (OR: 1.26; 95% CI: 1.02-1.54) and hypoglycaemia (OR: 1.49; 95% CI: 1.07-2.06). Conclusions: Perinatal stroke is associated with multiple risk factors. Exposure to smoking, 10-min Apgar score < 7 , neonatal infection and hypoglycaemia were independent risk factors. Emergency caesarean section, resuscitation at birth and abnormal cord blood gas were additional risk factors.

PMID: [36786434](#)

20. Orthopaedic Diagnoses in the Black Pediatric Population

Carla M Bridges, Rashmi Agarwal, Ellen M Raney

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The Black pediatric population is one that has been historically underserved and continues to have unmet needs. Factors including lack of diversity in orthopaedic studies and in historical standards, such as bone age, may inadvertently lead to inferior care. There are certain conditions in this population for which the practicing orthopaedic surgeon should have a higher degree of suspicion, including slipped capital femoral epiphysis, Blount disease, and postaxial polydactyly. Systemic diseases with higher rates in this population have orthopaedic manifestations, including sickle cell disease, vitamin D deficiency, and obesity. Racial discrepancies in access to prenatal care can have orthopaedic consequences for babies, especially cerebral palsy and myelodysplasia. Racial discrepancy exists in evaluation for nonaccidental trauma. Increased awareness of these issues better prepares practitioners to provide equitable care.

PMID: [36800541](#)**21. The Role of the Interleukin-1 Family in Complications of Prematurity**

Elys A Green, Steven P Garrick, Briana Peterson, Philip J Berger, Robert Galinsky, Rod W Hunt, Steven X Cho, Jane E Bourke, Marcel F Nold, Claudia A Nold-Petry

Review Int J Mol Sci. 2023 Feb 1;24(3):2795. doi: 10.3390/ijms24032795.

Preterm birth is a major contributor to neonatal morbidity and mortality. Complications of prematurity such as bronchopulmonary dysplasia (BPD, affecting the lung), pulmonary hypertension associated with BPD (BPD-PH, heart), white matter injury (WMI, brain), retinopathy of prematurity (ROP, eyes), necrotizing enterocolitis (NEC, gut) and sepsis are among the major causes of long-term morbidity in infants born prematurely. Though the origins are multifactorial, inflammation and in particular the imbalance of pro- and anti-inflammatory mediators is now recognized as a key driver of the pathophysiology underlying these illnesses. Here, we review the involvement of the interleukin (IL)-1 family in perinatal inflammation and its clinical implications, with a focus on the potential of these cytokines as therapeutic targets for the development of safe and effective treatments for early life inflammatory diseases.

PMID: [36769133](#)**22. Association between the General Movement Optimality Score and clinical features in newborns during hospitalization: A cross-sectional study**

Geruza Souza Mallmann, Andressa Lagoa Nascimento França, Priscila Rimoli Almeida, Lucimeire Souza Oliveira, Leila Simone Foerster Mery, Daniele Almeida Soares-Marangoni

Early Hum Dev. 2023 Feb 2;177-178:105720. doi: 10.1016/j.earlhumdev.2023.105720. Online ahead of print.

Aims: To describe the General Movements (GMs) of hospitalized newborns to verify if their global and detailed GMA are related and if their GMs are associated with clinical features. **Methods:** Cross-sectional study. Thirty-eight preterm and full-term newborns, who were hospitalized in the neonatal intermediate care unit of a reference hospital, were included. Prechtl's General Movement Assessment (GMA), including the General Movement Optimality Score (GMOS) list, was used as an assessment tool. Clinical variables, such as preterm birth, birthweight, length of hospitalization, Apgar scores, pregnancy problems, admission at neonatal intensive care unit, use of invasive mechanical ventilation, and brain imaging findings were also collected. Newborns were videoed at a single time for 3 min before discharge. **Results:** Most newborns presented GMs with normal or poor repertoire quality. GMOS ranged from 17 to 42 points. Scores were lower in abnormal GMs. Abnormal GMs were associated with preterm birth, length of hospital stay >30 days and birthweight <2500 g. Accordingly, lower GMOSs were also associated with preterm birth, a birthweight <2500 g and a hospital stay >30 days but also with the invasive mechanical ventilation application. **Conclusion:** Preterm and full-term newborns presented normal or abnormal GMs during hospitalization. Preterm birth, low birthweight, longer hospital stay and a time period of invasive ventilation were associated with worse GM behaviors.

PMID: [36773505](#)

23. Building Blocks for Deep Phenotyping in Infancy: A Use Case Comparing Spontaneous Neuromotor Functions in Prader-Willi Syndrome and Cerebral Palsy

Dajie Marschik-Zhang, Jun Wang, Xiushu Shen, Xiaoyun Zhu, Herong Gao, Hong Yang, Peter B Marschik

J Clin Med. 2023 Jan 18;12(3):784. doi: 10.3390/jcm12030784.

With the increasing worldwide application of the Prechtl general movements assessment (GMA) beyond its original field of the early prediction of cerebral palsy (CP), substantial knowledge has been gained on early neuromotor repertoires across a broad spectrum of diagnostic groups. Here, we aimed to profile the neuromotor functions of infants with Prader-Willi syndrome (PWS) and to compare them with two other matched groups. One group included infants with CP; the other included patients who were treated at the same clinic and turned out to have inconspicuous developmental outcomes (IOs). The detailed GMA, i.e., the motor optimality score-revised (MOS-R), was used to prospectively assess the infants' (N = 54) movements. We underwent cross-condition comparisons to characterise both within-group similarities and variations and between-group distinctions and overlaps in infants' neuromotor functions. Although infants in both the PWS and the CP groups scored similarly low on MOS-R, their motor patterns were different. Frog-leg and mantis-hand postures were frequently seen in the PWS group. However, a PWS-specific general movements pattern was not observed. We highlight that pursuing in-depth knowledge within and beyond the motor domain in different groups has the potential to better understand different conditions, improve accurate diagnosis and individualised therapy, and contribute to deep phenotyping for precision medicine.

PMID: [36769434](#)

24. Neurodevelopmental Outcome at Two Years for Preterm Infants With Intraventricular Hemorrhage: A Case-Control Study

Marion Honnorat, Franck Plaisant, Arnaud Serret-Larmande, Olivier Claris, Marine Butin

Pediatr Neurol. 2023 Jan 24;141:52-57. doi: 10.1016/j.pediatrneurol.2023.01.013. Online ahead of print.

Background: High-grade intraventricular hemorrhage (IVH), including grade III and grade IV IVH, is known to impact neurodevelopmental outcome of preterm infants, but prognosis remains difficult to establish due to confounding factors and significant variations in the reported outcomes. The aim of this study was to compare the neurodevelopmental outcome of preterm infants with or without severe IVH. Methods: A retrospective case-control study was conducted including preterm infants with gestational age <32 weeks hospitalized between 2009 and 2017 in a level III neonatal intensive care unit. This study included 73 cases with high-grade IVH and 73 controls who were matched to cases, based on the same gestational age, birth weight, sex, and year of birth. The neurodevelopmental outcome was compared at two years of age corrected for prematurity between cases and controls. Neurodevelopmental impairment was defined as cerebral palsy, hearing deficiency, visual impairment, or developmental delay. Multivariate analysis was used to identify whether high-grade IVH was an independent risk factor for neurodevelopmental impairment. Results: In univariate analysis, high-grade IVH was associated with death or poor neurodevelopmental outcome at two years of age corrected for prematurity (odds ratio [OR], 16.3; 95% confidence interval [CI], 5.93 to 57.8; $P < 0.001$), and this association remained significant after adjusting for confounding factors including neonatal infection and bronchopulmonary dysplasia in multivariate analysis (OR, 8.71; 95% CI, 2.48 to 38.09; $P = 0.002$). Conclusions: This study highlights the impact of high-grade IVH as an independent risk factor of poor neurodevelopmental outcomes in very preterm infants and suggests that early interventions could improve the prognosis of these infants.

PMID: [36773407](#)

25. Cerebellar deep brain stimulation for the treatment of movement disorders in cerebral palsy

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J Neurosurg. 2023 Feb 10;1-10. doi: 10.3171/2023.1.JNS222289. Online ahead of print.

Objective: Cerebral palsy (CP) represents the most common childhood physical disability that encompasses disorders of movement and posture attributed to nonprogressive disturbances that occurred in the developmental fetal or infant brain. Dyskinetic CP (DCP), the second most common type of CP after spastic forms, refers to a subset of patients in whom dystonia

and choreoathetosis are the predominant motor manifestations. Most children with CP have abnormal brain MRI studies indicative of cortical and deep gray matter damage consistent with hypoxic ischemic encephalopathy, which may preclude or suggest decreased efficacy of standard deep brain stimulation (DBS) targets. The cerebellum has been posited as an attractive target for treatment of DCP because it is frequently spared from hypoxic ischemic damage and has shown promise in alleviating patient symptoms both in early work in the 1970s and in more recent case series with DBS. Methods: The authors performed bilateral cerebellar DBS implantation, targeting the dentate nucleus (DN) and cerebellar outflow pathway, in 3 patients with DCP. Leads were connected to a pulse generator that senses local field potentials during chronic continuous DBS. The authors report their surgical methods, examples of chronic cerebellar local field potential recordings, and preliminary clinical outcomes. Motor outcomes were assessed using the Burke-Fahn-Marsden Dystonia Rating Scale. Results: Three patients 14-22 years old with DCP and MRI evidence of structural damage to the basal ganglia were offered cerebellar stimulation targeting the DN. All patients tolerated the procedure well and demonstrated improvement in subjective motor function as well as objective improvement in the Burke-Fahn-Marsden Dystonia Rating Scale movement subscale, although the range of responses was variable (19%-40%). Patients experienced subjective improvement in motor function including ease of hand movements and coordination, gait, head control, speech, decreased overflow, and diminished muscle tightness. Conclusions: DBS of the dentate nuclei in patients with DCP appears to be safe and shows preliminary evidence of clinical benefit. New chronic sensing technology may allow for determination of in vivo mechanisms of network disruption in DCP and allow for further understanding of the effects of neuromodulation on brain physiology. Larger studies with long-term follow up will be required to further elucidate the clinical benefits of this therapy. This report addresses a gap in the literature regarding the technical approach to image-based stereotactic targeting and chronic neural recording in the DN.

PMID: [36789999](#)

26. Content Validation of the Movement Disorder-Childhood Rating Scale (MD-CRS) for Dyskinetic Cerebral Palsy

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Pediatr Neurol. 2022 Dec 15;141:65-71. doi: 10.1016/j.pediatrneurol.2022.12.005. Online ahead of print.

Background: Dyskinetic cerebral palsy (DCP), a lifelong neurological disorder beginning in early childhood, manifests with hyperkinetic movements and dystonia. The Movement Disorder-Childhood Rating Scale (MD-CRS) is a clinician-reported outcome measure assessing the intensity of movement disorders and their effect on daily life in pediatric patients. Content validity of clinical outcome assessments is key to accurately capturing patient perspective. Evidence demonstrating content validity of the MD-CRS in patients with DCP is needed. This study captures input from patients with DCP and their caregivers regarding the content validity of the MD-CRS. Methods: This qualitative, noninterventional, cross-sectional study included interviews with children/adolescents (aged six to 18 years) with DCP and caregivers of children with DCP. Participants were asked to describe body regions and daily functions affected by DCP. Caregivers also reviewed MD-CRS Part I to evaluate the relevance of the items and corresponding response options. Descriptions of DCP were coded and mapped to MD-CRS items and response options. Caregiver feedback on MD-CRS Part I was analyzed using inductive content analysis. Results: Eight patients and 12 caregivers were interviewed. Participants confirmed that the body regions and activities listed in the MD-CRS were affected by DCP and that involuntary movements interfered with all motor, oral/verbal, self-care, and video protocol activities. Caregivers endorsed the response options for 12 of 15 items in MD-CRS Part I and suggested clarifications for others. Conclusions: Participants confirmed that affected body regions and activities listed in the MD-CRS were relevant to their experience with DCP, demonstrating the content validity of this tool in children/adolescents with DCP.

PMID: [36774682](#)

27. The perceived impact of Covid-19 pandemic on the children with cerebral palsy: the parents' perspective explored within the "6-F words" framework

Silvia Pizzighello, Marianna Uliana, Michela Martinuzzi, Matteo G F Vascello, Martina Cipriani, Martina Breda, Gianni De Polo, Andrea Martinuzzi

Child Adolesc Psychiatry Ment Health. 2023 Feb 15;17(1):24. doi: 10.1186/s13034-023-00569-z.

Background: In 2020 the world faced the spread of the coronavirus infection disease (Covid-19). This was a general public health emergency but many people with disabilities might have been particularly affected. Objective: This paper aims to investigate the impact of the Covid-19 pandemic on children with Cerebral Palsy (CP) and their families. Methods: 110 parents

of children with CP (aged 2 to 19) who completed a questionnaire were included. These children were under the care of one of the Italian Children Rehabilitation Centers. Socio-demographic and clinical information about patients and their families were collected. In addition, difficulties on adopting protective measures and in respecting lockdown rules by children were explored. We adopted the ICF (International Classification of Functioning, Disability and Health) framework to create multiple choice questions. Descriptive statistics were reported and logistic regression analyses were run in order to identify the predictors of perceived impairment in motor, speech, manual and behavioral abilities. Results: Daily activities of children, as well as rehabilitation and fitness sessions, underwent a change during the pandemic. Spending more time with family due to lockdown measures, has had, in some cases a positive effect however there was a perceived decrease in rehabilitation support and school activities. The age range (between 7 and 12 years) and difficulty in respecting rules emerged as significant predictors of the perceived impairment due to Covid-19 pandemic. Conclusions: The pandemic has had different impacts on children and their families on the basis of children's characteristics. Rehabilitation activities during a hypothetical lockdown should consider these characteristics.

PMID: [36793119](#)

28. Attitude of Parents of Children with Cerebral Palsy Towards COVID-19 Vaccination

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Int J Environ Res Public Health. 2023 Jan 20;20(3):1909. doi: 10.3390/ijerph20031909.

Children with cerebral palsy (CP) are at a greater risk of respiratory complications from coronavirus disease 2019 (COVID-19). Therefore, this study aimed to assess COVID-19 vaccine hesitancy (VH) among parents of CP children in Egypt, using the Arabic version of the Parental Attitude about Childhood Vaccination (PACV) questionnaire. This cross-sectional survey study was conducted at the outpatient clinics of two hospitals in Cairo, Egypt. Parents of children with CP were recruited using a simple random sampling technique. A total of 321 parents were enrolled; more than half of them were mothers of the children (61.37%); and the majority were Egyptians (87.23%) and living in urban areas (84.42%). Nearly 70% of the parents were hesitant to administer the COVID-19 vaccine to their children. A multiple linear regression model revealed that the PACV mean scores were lower among the following categories: (1) parents who could pay back loans, compared to those who could not pay back loans and who reported insufficient income ($\beta = -2.39$, $p = 0.030$); (2) non-Egyptian parents ($\beta = -1.54$, $p = 0.002$); (3) those who were fully vaccinated against COVID-19 themselves or had the intention to receive the complete COVID-19 vaccination ($\beta = -6.28$, $p < 0.001$); (4) those who had the intention to give the COVID-19 vaccination to their children ($\beta = -3.04$, $p < 0.001$); and (5) parents whose children received routine vaccines ($\beta = -2.86$, $p < 0.045$). After adjusting for other covariates, the parental COVID-19 vaccine status ($\beta = -6.28$, $p < 0.001$) and parents who experienced a COVID-19-related death in the family ($\beta = -1.75$, $p < 0.001$) showed significantly lower mean PACV scores. However, higher mean PACV scores were reported among parents who had a COVID-19 infection ($\beta = 2.77$, $p < 0.001$) or who were not sure ($\beta = 2.94$, $p < 0.001$). Our findings suggest the need to increase COVID-19 vaccine acceptance among parents of vulnerable children to reduce the negative consequences of COVID-19.

PMID: [36767281](#)