Cerebral palsy research news

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Interventions and Management

1. Cortical Hemodynamic Response and Networks in Children with Cerebral Palsy During Upper Limb Bilateral Motor Training
Tengyu Zhang, Gongcheng Xu, Congcong Huo, Wenhao Li, Zengyong Li, Wei Li

J Biophotonics. 2023 Jan 5;e202200326. doi: 10.1002/jbio.202200326. Online ahead of print.

Understanding the characteristics of functional brain activity is important for motor rehabilitation of children with cerebral palsy (CP). Using the functional near-infrared spectroscopy (fNIRS) technology, the cortical response and networks of prefrontal (PFC) and motor cortices (MC) were analyzed for children with CP and typical development (CTD). Compared with CTD, the resting cortical response of dominant MC in children with CP increased, and the functional connectivity between cerebral areas decreased. In the motor state of children with CP, the coupling strength started from dominant MC increased compared with resting state, and the hemispherical autonomy index (HAI) of the dominant MC was higher than that in the CTD, which reflected the leading role of dominant MC in brain regulation during motor. The functional connectivity between bilateral MC was positively correlated with motor performance. This study provided effective indices for evaluating the motor function and real-time impact of motor on brain networks.

PMID: 36602536

2. Effect of Intrathecal Baclofen Pump on Scoliosis in Children With Cerebral Palsy: A Meta-Analysis
Soolim Lee, Cheolhwan Hyun, Kyungmin Kim, Hyo Eun Kwon, Minwoo Woo, Seong-Eun Koh

Ann Rehabil Med. 2023 Jan 4. doi: 10.5535/arm.22108. Online ahead of print.

Objective: To systematically review the effect of intrathecal baclofen pump insertion in children with cerebral palsy (CP) with respect to scoliosis. Methods: A systematic literature search was conducted in PubMed, Embase, Cochrane Library, and Google Scholar databases up to June 2022. The inclusion criteria were as follows: (1) studies with a quantitative study design; (2) studies with a study group of children with CP; (3) studies comparing scoliosis in children with and without an intrathecal baclofen pump; and (4) studies with Cobb's angle as a parameter. Results: Of the 183 studies found, four studies, all of which were retrospective comparative studies, met the aforementioned inclusion criteria. All studies were homogeneous (I2=0%, p=0.53) and intrathecal baclofen pump insertion accelerated the progression of scoliosis (standard mean difference=0.27; 95% confidence interval=0.07-0.48). Conclusion: Intrathecal baclofen pumps have been used to alleviate spasticity in children with CP, thus aiding their daily activities and movements. However, their advantages and disadvantages should be reviewed after sufficient time considering the pumps' negative effect on the course of scoliosis.

PMID: 36599295

3. Letter to the Editor. Intrathecal baclofen pump insertion versus selective dorsal rhizotomy
Anna Bruna Ronchetti, Marta Bertamino, Chiara Maria Tacchino, Paolo Moretti, Marco Pavanello

J Neurosurg Pediatr. 2022 Sep 30;30(6):634-635. doi: 10.3171/2022.7.PEDS22276.

No abstract available

PMID: 36593674

4. Commentary on "Predictors of postoperative systemic inflammatory response syndrome after scoliosis surgery in adolescents with cerebral palsy: A retrospective analysis"
Oghenewoma P Oghenesume, Jonathan N Grauer

N Am Spine Soc J. 2022 Sep 19;12:100173. doi: 10.1016/j.xnsj.2022.100173. eCollection 2022 Dec.

No abstract available

PMID: 36589691

5. Surgical Strategies and Perioperative Considerations for Cervical Deformity With Cerebral Palsy: A Comprehensive Review of the Literature
Hyung Cheol Kim, Sung Han Oh, Jae Keun Oh, Yoon Ha

Neurospine. 2022 Dec;19(4):868-875. doi: 10.14245/ns.2244956.478. Epub 2022 Dec 31.

The complex nature of the cervical spine makes surgical intervention challenging when treating cervical deformity in patients with cerebral palsy (CDCP). However, few studies have investigated the unique characteristics of cerebral palsy that create the need for surgery, the most effective surgical strategies, and the possible perioperative complications. The intended benefit and the potential risk of postoperative complications must be considered when deciding to operate for CDCP. Because the approach and correction strategy depend on the type of cervical deformity, as well as the patient's comorbidities and functional status, a customized strategy is needed. Perioperatively, botulinum toxin injections and muscle division techniques can help control excessive involuntary movements and improve the spinal fusion success rate. Surgical intervention for CDCP requires a multidisciplinary approach, and the information presented in this article is intended to help in the perioperative management and surgical treatment of CDCP.

PMID: 36597622

6. Hip Displacement Does Not Change After Pelvic Obliquity Correction During Spinal Fusion in Children With Cerebral Palsy
Ali Asma, Mutlu Cobanoglu, Armagan Can Ulusaloglu, Kenneth J Rogers, Freeman Miller, Jason J Howard, Suken A Shah, M Wade Shrader

J Pediatr Orthop. 2023 Feb 1;43(2):e127-e131. doi: 10.1097/BPO.0000000000002292. Epub 2022 Nov 15.

Background: Children with cerebral palsy (CP) frequently develop both neuromuscular hip dysplasia and scoliosis, and occasionally, the timing of the worsening of both of these pathologies is concurrent. The question as to whether the hip or spine should be addressed first in CP remains controversial, with the majority of evidence being "expert opinion." The purpose of this project was to determine the impact of posterior spinal fusion (PSF) on the change in hip displacement for children with CP without previous reconstructive hip surgery. Methods: This was an Institutional Review Board-approved study that observed 67 patients from 2004 to 2018. Inclusion criteria included children with CP, 18 years of age and younger, Gross Motor Function

Classification System IV and V, undergoing PSF at a single tertiary care children's hospital with a minimum 2-year follow-up. The primary outcome was the change in hip displacement as quantified by the migration percentage (MP). The hip with the highest MP (worst hip) at the spine preoperative analysis were included for analysis. Triradiate cartilage (TRC) status and pelvic obliquity correction were analyzed with multivariate analysis. Results: Sixty-seven patients were included for analysis, with a mean age of 12.5±2.3 years. The mean major curve angle of the major curve was 77±23 degrees and the mean preoperative pelvic obliquity was 21±12 degrees. There was no statistically significant change in MP after PSF from a mean preoperative value of 41±27%, to a mean postoperative value of 41±29% at the last follow-up, (P=0.76) The mean follow-up time was 4.1±2.7 years. TRC status (P=0.52) and the severity of pelvic obliquity (P=0.10) did not statistically impact the change in MP after PSF. Conclusion: PSF did not influence-either negatively or positively-the progression of hip displacement in children with CP, regardless of pelvic obliquity correction or TRC status. The lack of deterioration in hip displacement post-PSF, however, may suggest a protective effect of spine surgery. Level of evidence: Level III-retrospective cohort study.

PMID: 36607919

7. Femoral Head Deformity Associated With Hip Displacement in Nonambulatory Cerebral Palsy: Results at Skeletal Maturity
Armagan C Ulusaloglu, Ali Asma, Kenneth J Rogers, M Wade Shrader, Freeman Miller, Jason J Howard

J Pediatr Orthop. 2022 Dec 23. doi: 10.1097/BPO.0000000000002333. Online ahead of print.

Background: Maintaining femoral head shape (FHS) and acetabular sphericity are important goals in preventing long-term osteoarthritis in hips in children with cerebral palsy (CP). As acetabular morphology has been widely studied, our objective was to determine FHS in CP after triradiate cartilage (TRC) closure, a proxy for skeletal maturity, and the risk factors associated with residual deformity and osteoarthritis. Methods: In this retrospective cohort study, patients with CP [Gross Motor Function Classification System (GMFCS) IV to V], minimum 4 yearly hip radiographs after age 10 years, and at least 1 radiograph after age 16 years, were included. Primary outcome was FHS (Rutz), stratified as "less severe" (Rutz A to B) and "more severe" (Rutz C to D). Secondary outcomes included migration percentage (MP), age at TRC closure, previous reconstructive (femoral with/without pelvic osteotomies) surgery, previous intrathecal baclofen, Tönnis osteoarthritis grade, and GMFCS level. Statistical analyses included $\chi 2$ analysis and multiple logistic regression. Results: One hundred sixty-three patients (326 hips) met the inclusion criteria, with TRC closure at age 14.0 (SD: 1.8) years. At final follow-up of 4.4 (SD: 2.4) years after TRC closure, 17% (55 hips), had a "more severe" FHS. From TRC closure to final follow-up, the frequencies of "less severe" hips decreased (-10%, P<0.001), while "more severe" increased (+115%, P<0.001). In multiple regression analysis, MP at TRC closure was the only significant risk factor associated with a "more severe" FHS at final follow-up (P=0.03). Receiver operating characteristic curve analysis determined MP≥30.5% to be associated with a "more severe" FHS at final follow-up (P<0.009). The FHS was not affected by reconstructive surgery, sex, GMFCS level, or intrathecal baclofen use. "Less severe" hips had lower Tönnis grades (0 to 1) compared with "more severe" hips (Tönnis grades 2 to 3) at final follow-up (P<0.001). Conclusions: No need for determinent FHS at skeletal maturity was not influenced by prior reconstructive surgery but was negatively affected when MP≥30.5% at the time of TRC closure. The extent of residual femoral head deformity correlated with the severity of osteoarthritis at final follow-up. Level of evidence: Level III.

PMID: 36563091

8. Three different techniques for pelvic fixation in the management of neuromuscular scoliosis in nonambulatory spastic cerebral palsy: A comparative study of Galveston Rod, iliac screw, and sacroiliac screw
Armağan Can Ulusaloğlu, Ali Asma, J Richard Bowen, Suken A Shah

Acta Orthop Traumatol Turc. 2022 Nov;56(6):372-376. doi: 10.5152/j.aott.2022.22080.

Objective: This study aimed to compare the clinical and radiographic results of three different pelvic fixation techniques, i.e., Galveston Rod, Iliac Screw, and Sacroiliac Screw, in managing neuromuscular scoliosis in nonambulatory children with spastic cerebral palsy (CP). Methods: This retrospective study included nonambulatory children aged < 18 years with neuromuscular scoliosis secondary to CP, undergoing a spinal fusion and pelvic fixation by either Galveston rod, iliac screw, or sacroiliac screw techniques. The primary outcome variable was to determine the stability of the major curve angle and pelvic obliquity over timeline intervals for each pelvic fixation tech nique. The two radiographic parameters were measured at five timeline intervals and were compared to define stability among the groups. Results: One hundred and one patients (54 females [53%]) with spastic nonambulatory CP met the inclusion criteria; the mean age at sur gery was 13.5±3.1 years. Mean follow-up

intervals were first-year (12.9±1.5) and second-year (25.8±2.5). Forty-one patients had minimum five-year (81.5±23 months) postoperative follow-up. Groups were based on pelvic fixation techniques: 25 patients with the Galveston rod, 24 with the iliac screw, and 52 with the sacroiliac screw. Of the 41 patients with a minimum five-year follow-up, 10 had the Galveston rod, 11 had an iliac screw, and 20 had sacroiliac screw fixation. Gross Motor Function Classification System level, medical comorbidities, intra thecal baclofen pump, and vitamin D level were compared with each pelvic fixation technique (P > .05). Major curve angle parameters were measured at the five timelines as 70.5°±21.1°, 15.7°±13°, 15.7°±12°, 17.5°±12.7°, and 15.1°±9.6°, and pelvic obliquity as 14.8°±10.4°, 4.9°±4.2°, 5.7°±4.6°, 5°±4.4°, and 7.2°±4.4°, respectively. After the surgery, corrected major curve angle and pelvic obliquity showed no sta tistically significant difference between pelvic fixation techniques (P > .05) and remained stable over timeline intervals (P > .05). Fifteen patients had complications requiring additional surgery. The iliac screw group (nine patients) had the highest rate of complications. Conclusion: All three pelvic fixation techniques can provide equivalent correction for major curve angle and pelvic obliquity in managing neuromuscular scoliosis in nonambulatory CP children. Pelvic obliquity after surgery may remain stable regardless of pelvic fixation type. A higher rate of postoperative complication can be encountered with the iliac screw. Level of evidence: Level III, Retrospective Study.

PMID: 36567539

9. Hip Displacement After Triradiate Cartilage Closure in Nonambulatory Cerebral Palsy: Who Needs Continued Radiographic Surveillance?
Ali Asma, Armagan Can Ulusaloglu, M Wade Shrader, Freeman Miller, Kenneth J Rogers, Jason J Howard

J Bone Joint Surg Am. 2023 Jan 4;105(1):27-34. doi: 10.2106/JBJS.22.00648. Epub 2022 Nov 18.

Background: Recommendations with regard to the need for continued hip surveillance after skeletal maturity are based on expert opinion rather than evidence. This study aimed to determine the prevalence of and risk factors associated with progressive hip displacement in cerebral palsy (CP) after triradiate cartilage (TRC) closure. Methods: Patients who had spastic nonambulatory CP (Gross Motor Function Classification System IV to V) and hypertonic (spastic or mixed-type) motor type and follow-up of at least 2 years after TRC closure were included. The primary outcome variable was the hip migration percentage (MP). The secondary outcome variables included patient age at the time of TRC closure, prior preventative or reconstructive surgery, a prior intrathecal baclofen pump, history of scoliosis, history of epilepsy, a prior gastrostomy tube, a previous tracheostomy, and gender. An unsuccessful hip outcome was defined as a hip with an MP of ≥40% and/or requiring a reconstructive surgical procedure after TRC closure. Results: In this study, 163 patients met the inclusion criteria, with a mean follow-up of 4.8 years (95% confidence interval [CI], 4.4 to 5.1 years) after TRC closure at a mean patient age of 14.0 years (95% CI, 13.7 to 14.3 years). Of these hips, 22.1% (36 of 163) had an unsuccessful hip outcome. In multivariate analysis, the first MP at TRC closure (hazard ratio [HR] per degree, 1.04; $p < 0.001$) and pelvic obliquity (HR per degree, 1.06; $p = 0.003$) were independent risk factors for an unsuccessful hip outcome, but gender was not found to be significant (HR for male gender, 1.7 [95% CI, 0.8 to 3.58; $p = 0.16$]; female gender was the reference). However, the mean survival time for progression to an unsuccessful hip outcome was longer for female patients at 9.2 years [95% CI, 8.1 to 10.2 years]) compared with 6.2 years (95% CI, 5.6 to 6.9 years) for male patients ($p = 0.02$). There was also a significant improvement in survivorship for prior reconstructive surgical procedures ($p = 0.002$). The survivorship in patients who underwent reconstructive surgery performed at a patient age of ≥6 years was significantly higher compared with those who underwent surgery performed at <6 years of age ($p < 0.05$). A first MP at TRC closure of ≥35% was associated with an unsuccessful hip outcome, as determined by receiver operating characteristic (ROC) curve analysis ($p < 0.001$; area under the ROC curve of 0.891, sensitivity of 81%, and specificity of 94%). Conclusions: The risk factors for the progression of hip displacement after TRC closure in patients with CP included a higher MP and increased pelvic obliquity; there was decreased survivorship for male patients and patients with no prior reconstructive surgery. Patients with these risk factors and/or an MP of ≥35% at TRC closure should have continued radiographic surveillance to detect late hip displacement. Level of evidence: Prognostic Level III . See Instructions for Authors for a complete description of levels of evidence.

PMID: 36575164

10. Total Hip Arthroplasty in Patients With Neurological Conditions: A Systematic Review
Conor S O'Driscoll, Andrew J Hughes, Martin S Davey, Joseph M Queally, Brendan J O'Daly

Arthroplast Today. 2022 Dec 12;19:101068. doi: 10.1016/j.artd.2022.11.001. eCollection 2023 Feb.

Background: As operative techniques and implant design have evolved over time, total hip arthroplasty (THA) is increasingly

being carried out for patients with neurological impairment. This patient group places unique surgical challenges to the arthroplasty surgeon, which may include contractures, instability, and altered muscular tone. The purpose of this systematic review is to report the patient outcomes, complications, and implant survival following THA for patients with neurological conditions affecting the hip. Thus, we aim to support orthopaedic surgeon decision-making when considering and planning THA for these patients. Methods: A systematic review was performed as per Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines using the PubMed/Medline OVID, Cochrane, and Embase databases. All studies reporting the outcomes of THA in the neurological population which met defined inclusion criteria were included. Results: From an initial screen of 1820 studies, 45 studies with a total of 36,251 THAs were included in the final selection. All 45 studies reported complication rates, with controls included in 16 for comparison. High complication rates were observed following THA in the neurologically impaired population, most notably dislocation with observed rates up to 10.6%. An improvement was noted in all 36 studies (1811 THAs) which reported upon patient-reported outcomes. Conclusions: THA may be beneficial in the selected patients with neurological conditions, to reduce pain and improve function. There is an increased risk of complications which require careful consideration when planning the operation and open discussion with prospective patients and caregivers before proceeding with surgery.

PMID: 36568851

11. Acquired Hip Dysplasia in Children with Congenital Zika Virus Infection in the First Four Years of Life
Marcos Vinicius da Silva Pone, Tallita Oliveira Gomes da Silva, Carla Trevisan Martins Ribeiro, Elisa Barroso de Aguiar, Pedro Henrique Barros Mendes, Saint Clair Dos Santos Gomes Junior, Tatiana Hamanaka, Andrea Araujo Zin, José Paulo Pereira Junior, Maria Elisabeth Lopes Moreira, Karin Nielsen-Saines, Sheila Moura Pone

Viruses. 2022 Nov 26;14(12):2643. doi: 10.3390/v14122643.

Acquired hip dysplasia has been described in children with cerebral palsy (CP); periodic surveillance is recommended in this population to prevent hip displacement and dislocation. Children with congenital zika syndrome (CZS) may present a spectrum of neurological impairments with changes in tonus, posture, and movement similar to children with CP. However, the relationship between CZS and hip dysplasia has not been characterized. In this prospective cohort study, we aimed to describe the occurrence of hip dysplasia in patients with CZS. Sixty-four children with CZS from 6 to 48 months of age were included and followed at a tertiary referral center in Rio de Janeiro, Brazil, with periodic radiologic and clinical hip assessments. Twenty -six (41%) patients were diagnosed with hip dysplasia during follow-up; mean age at diagnosis was 23 months. According to the Gross Motor Function Classification System (GMFCS), 58 (91%) patients had severe impairment (GMFCS IV and V) at the first evaluation. All patients with progression to hip dysplasia had microcephaly and were classified as GMFCS IV or V. Pain and functional limitation were reported by 22 (84%) caregivers of children with hip dysplasia. All patients were referred to specialized orthopedic care; eight (31%) underwent surgical treatment during follow-up. Our findings highlight the importance of implementing a hip surveillance program and improving access to orthopedic treatment for children with CZS in order to decrease the chances of dysplasia-related complications and improve quality of life.

PMID: 36560649

12. The impact of instrumented gait analysis on decision-making in the interprofessional management of cerebral palsy: A scoping review
Anna Hebda-Boon, Xiang-Li Tan, Ricarda Tillmann, Adam P Shortland, Gregory B Firth, Dylan Morrissey

Review Eur J Paediatr Neurol. 2022 Dec 9;42:60-70. doi: 10.1016/j.ejpn.2022.11.007. Online ahead of print.

Background: Management of gait-related problems in children and young people with Cerebral Palsy (CYPwCP) is complex and requires an interprofessional approach. Irrespective of underlying mechanisms, instrumented gait analysis (IGA) can provide quantification of gait to support clinical decision-making for CYPwCP when planning treatment interventions. Aim: This scoping review aimed to determine the impact of instrumented gait analysis (IGA) on treatment decision-making for CYPwCP, paying particular attention to interprofessional decision-making. Method: PubMed, EMBASE, Web of Science and Scopus databases were searched from inception to October 2019 for studies including CYPwCP age<25 years. The PRISMA ScR protocol was followed, and Quality was assessed with the Downs and Black (D&B) scale. Influences on decision-making were coded according to the International Classification of Functioning, Disability and Health for Children and Youth framework (ICF-CY). Results: Seventeen studies (1144 patients, 2.8-23 years) of varying quality (mean D&B = 17.2, range = 11-26) were included. Studies considered IGA influence at three decision-making stages 'Clinical Planning', 'Treatment

Performed' and 'Follow up'. Child and Family, and Clinician and Service-centred factors had a high impact on engagement with IGA recommendations. Interpretation: IGA guided recommendations can differ from initial clinical plans, and often lead to modification of the treatment ultimately performed. The effect on individual patients' outcomes when treatment recommendations based on instrumented gait analysis are followed is not yet clear and warrants further research. The differences in clinicians' engagement with IGA recommendations occur due to an array of Child and Family, and Clinician and Service-centred factors. Overall, IGA leads to less surgical recommendations, and has the potential to influence conservative gait-related management in CYPwCP.

PMID: 36563467

13. The relationship between the backward walking and proprioception, trunk control, and muscle strength in children with cerebral palsy
Enver Katırcı, Hatice Adıgüzel, Zekiye İpek Katırcı Kırmacı, Nevin Ergun

Ir J Med Sci. 2023 Jan 6. doi: 10.1007/s11845-022-03270-w. Online ahead of print.

Objective: This study was planned to determine the factors affecting backward walking in children with cerebral palsy (CP). Methods: The study included 30 children with CP, with a mean age of 10.43 ± 2.76 years. Backward walking abilities were evaluated with the 3-Meter Back Walk Test (3MBWT). A digital goniometer was used to evaluate proprioception, the Trunk Control Measurement Scale (TCMS) was used for trunk control, a digital muscle dynamometer was used for muscle strength, and the Gillette Functional Assessment Questionnaire (FAQ) was used for gait evaluation. Results: When the spasticity of children at levels I and II according to the Gross Motor Function Classification System (GMFCS) was compared, a significant difference was found in favor of level I in hamstring, gastro-soleus, and gastrocnemius spasticity ($p < 0.05$). When the results of the 3MBWT, TCMS, and FAQ were compared, a significant difference was found in favor of level I ($p < 0.05$). No significant relationship was revealed between the 3MBWT and lower extremity proprioception and TCMS ($p > 0.05$). A significant negative correlation was observed between the 3MBWT and FAQ ($p < 0.05$). No significant correlation was found between the 3MBWT and lower extremity muscle strengths ($p > 0.05$). A significant positive correlation was found only between hip extension proprioception and iliopsoas muscle strength ($p = 0.023$). There was no significant correlation between the FAQ and lower extremity muscle strength ($p > 0.05$). Conclusion: It was revealed that the backward walking ability increased as the forward walking function improved in children with CP, but it was not affected by proprioception, trunk control, and muscle strength. Clinical trials: NCT05088629 (10/11/2021).

PMID: 36604372

14. Relationship between kinematic gait quality and caregiver-reported everyday mobility in children and youth with spastic Cerebral Palsy
Matthias Hösl, Alexander Schupfinger, Luisa Klich, Linda Geest, Petra Bauer, Michaela V Bonfert, Faik K Afifi, Sean Nader, Steffen Berweck

Eur J Paediatr Neurol. 2022 Dec 5;42:88-96. doi: 10.1016/j.ejpn.2022.11.009. Online ahead of print.

Background: 3D gait analysis (3DGA) is a common assessment in Cerebral Palsy (CP) to quantify the extent of movement abnormalities. Yet, 3DGA is performed in laboratories and may thus be of debatable significance to everyday life. Aim: The aim was to assess the relationship between kinematic gait abnormality and everyday mobility in ambulatory children and youth with spastic CP. Methods: 73 paediatric and juvenile patients with uni- or bilateral spastic CP (N = 21 USCP, N = 52, BSCP, age: 4-20 y, GMFCS I-III) underwent a 3DGA, while the MobQues47 Questionnaire quantified caregiver-reported mobility. We calculated the Gait Profile Score (GPS), a metric that summarizes how far the lower limb joint angles during walking deviate from those of matched controls. Results: The GPS correlated well with indoor and outdoor mobility (rho = -0.69 and -0.70, both $p < 0.001$) and the relationships were not significantly different for USCP and BSCP. Still, mobility was lower in BSCP ($p < 0.001$) and more compromised outdoors ($p = 0.002$). Indoor mobility could be predicted by walking speed, GPS and age (adj. $R2 = 0.62$). Outdoor mobility was best predicted by walking speed and GPS (adj. $R2 = 0.60$). The additive explained variance by the GPS was even higher outdoors than indoors (17.1% vs. 11.4%). Conclusions: Measuring movement deviations with 3DGA seems equally meaningful in uni- and bilaterally affected children and has considerable relevance for real-life ambulation, particurlarly outdoors, where children with spastic CP typically face greater difficulties. Therapeutic strategies that achieve faster walking and reduction of kinematic deviations may increase outdoor mobility.

PMID: 36587415

15. Assessment of foot deformities in individuals with cerebral palsy using weight-bearing CT
R H H Wellenberg, W Schallig, P Steenbergen, P den Tex, J G G Dobbe, G J Streekstra, M M E H Witbreuk, A I Buizer, M Maas

Skeletal Radiol. 2022 Dec 30. doi: 10.1007/s00256-022-04272-6. Online ahead of print.

Objective: The aims of this study were to visualize and quantify relative bone positions in the feet of individuals with cerebral palsy (CP) with a foot deformity and compare bone positions with those of typically developed (TD) controls. Materials and methods: Weight-bearing CT images of 14 individuals with CP scheduled for tendon transfer and/or bony surgery and of 20 TD controls were acquired on a Planmed Verity WBCT scanner. Centroids of the navicular and calcaneus with respect to the talus were used to quantify foot deformities. All taluses were aligned and the size and dimensions of the individuals' talus were scaled to correct for differences in bone sizes. In order to visualize and quantify variations in relative bone positions, 95% CI ellipsoids and standard deviations in its principle X-, Y-, and Z-directions were determined. Results: In individuals with CP (age 11-17), a large variation in centroid positions was observed compared to data of TD controls. Radiuses of the ellipsoids, representing the standard deviations of the 95% CI in the principle X-, Y-, and Z-directions, were larger in individuals with CP compared to TD controls for both the calcaneus (3.16 vs 1.86 mm, 4.26 vs 2.60 mm, 9.19 vs 3.60 mm) and navicular (4.63 vs 1.55 mm, 5.18 vs 2.10 mm, 16.07 vs 4.16 mm). Conclusion: By determining centroids of the calcaneus and navicular with respect to the talus on WBCT images, normal and abnormal relative bone positions can be visualized and quantified in individuals with CP with various foot deformities.

PMID: 36585514

16. Surgical Management of Severe Equinus Deformity in Ambulatory Children With Cerebral Palsy
Khadija Soufi, Anita Bagley, Sean A Brown, David E Westberry, Vedant A Kulkarni, Prabhav Saraswat, Jon R Davids

J Pediatr Orthop. 2023 Feb 1;43(2):91-98. doi: 10.1097/BPO.0000000000002310. Epub 2022 Nov 25.

Background: Tendo Achilles lengthening (TAL) for the management of equinus contractures in ambulatory children with cerebral palsy (CP) is generally not recommended due to concerns of over-lengthening, resulting in weakness and plantar flexor insufficiency. However, in some cases, surgical correction of severe equinus deformities can only be achieved by TAL. The goal of this study is to assess the outcomes following TAL in these cases. Methods: A retrospective cohort study of children with CP with severe equinus contractures (ankle dorsiflexion with the knee extended of -20 degrees or worse) who underwent TAL as part of a single event multilevel surgery, with preoperative and postoperative gait analysis studies. Continuous data were analyzed by paired t test, and categorical data by McNemar Test. Results: There were 60 subjects: 42 unilateral, 18 bilateral CP; 41 GMFCS II, 17 GMFCS I; mean age at surgery was 10.6 years, mean follow-up was 1.3 years. Ankle dorsiflexion with the knee extended improved from -28 to 5 degrees ($P<0.001$). The ankle Gait Variable Score improved from 34.4 to 8.6 ($P<0.001$). The ankle moment in terminal stance improved from 0.43 to 0.97 Nm/kg ($P<0.001$). Significant improvements ($P<0.001$) were seen in radiographic measures of foot alignment following surgery. There were few significant differences in the outcome parameters between subjects with unilateral versus bilateral CP (eg, only the bilateral group showed improved but persistent increased knee flexion in mid-stance). Conclusions: The outcomes following TAL for the management of severe equinus deformity in ambulatory children with CP were favorable 1 year after surgery, with significant improvements in all domains measured. Significance: This study does not advocate for the widespread use of TAL to correct equinus deformity in children with CP. However, it does show that good short-term outcomes following TAL are possible in properly selected subjects with severe contractures when the dosing of the surgery is optimal (correction of contracture to between 0 and 5 degrees of dorsiflexion with the knee extended) and the procedure is performed in the setting of single event multilevel surgery with subsequent proper orthotic management and rehabilitation.

PMID: 36607920

17. Synergistic effect of functional strength training and cognitive intervention on gross motor function in children with cerebral palsy
Alaa Al-Nemr

Appl Neuropsychol Child. 2022 Dec 26;1-10. doi: 10.1080/21622965.2022.2159408. Online ahead of print.

Background: Cerebral palsy (CP) is a posture and movement disorder, however; it often includes disturbance of different aspects of cognitive function. This study aimed to investigate if combined functional strength training (FST) and cognitive intervention are more effective than either of them alone on gross motor function in children with spastic diplegic CP. Methods: Sixty-four children with spastic diplegic CP, with ages ranging from 8 to 12 years, were assigned randomly into four treatment groups; Group I; FST, group II; cognitive training, group III; combined FST and cognitive training, group IV; conventional physical therapy. The Gross Motor Function Measure (GMFM-88) was used to assess gross motor function at baseline, post-treatment, and 6 months follow-up. Results: Group III achieved a significant improvement in GMFM-88 when compared to other groups post-treatment and at follow-up. Conclusion: This study suggests that combined lower limb FST and cognitive intervention had the potential to produce significantly more favorable effects than the single use of either of them on gross motor function in children with spastic diplegia.

PMID: 36571210

18. Vibration therapy in young children with mild to moderate cerebral palsy: does frequency and treatment duration matter? A randomised-controlled study
Alena Adaikina, José G B Derraik, Paul L Hofman, Silmara Gusso

Randomized Controlled Trial BMC Pediatr. 2023 Jan 2;23(1):4. doi: 10.1186/s12887-022-03786-1.

Background: Vibration therapy (VT) has been increasingly studied in children with cerebral palsy (CP) over the last years, however, optimal therapeutic VT protocols are yet to be determined. The present study compared the effects of side-alternating VT protocols varying in frequency and treatment duration on the health of young children with mild-to-moderate CP. Methods: Thirty-four participants aged 6.0 to 12.6 years with CP acted as their own controls and underwent two consecutive study periods: a 12-week lead-in (control) period prior to the intervention period of 20-week side-alternating VT (9 min/session, 4 days/week), with the frequency either 20 Hz or 25 Hz, determined by randomisation. Participants had 4 assessment visits: baseline, after the control period, after 12-week VT (12VT), and after further 8 weeks of VT (20VT). Assessments included 6-minute walk test (6MWT); dual-energy x-ray absorptiometry; gross motor function; muscle function testing on the Leonardo mechanography plate and by hand-held dynamometry, and a quality-of-life questionnaire (CP QOL). Analysis was carried out using linear mixed models based on repeated measures. Results: Side-alternating VT was well-tolerated, with occasional mild itchiness reported. The median compliance level was 99%. VT led to improvements in 6MWT (+ 23 m; $p = 0.007$ after 20VT), gross motor function in standing skills (+ 0.8 points; $p = 0.008$ after 12VT; and + 1.3 points; $p = 0.001$ after 20VT) and in walking, running and jumping skills (+ 2.5 points; $p < 0.0001$ after 12VT; and + 3.7 points; $p < 0.0001$ after 20VT), spine bone mineral density z-score (+ 0.14; $p = 0.015$ after 20VT), velocity rise maximum of the chair rising test (+ 0.14 m/s; $p = 0.021$ after 20VT), force maximum of the single two-leg jump test (+ 0.30 N/kg; $p = 0.0005$ after 12VT; and + 0.46 N/kg; $p = 0.022$ after 20VT) and in the health module of CP QOL (+ 7 points; $p = 0.0095$ after 20VT). There were no observed differences between the two VT frequencies (i.e., 20 Hz vs 25 Hz) on study outcomes. Conclusions: The study confirms that side-alternating VT has positive effects on mobility, gross motor function, body composition, muscle function, and quality of life, independent of VT frequencies tested. Long-term, 20VT appears to be a more efficient treatment duration than a short-term, 12VT. Trial registration: Australian New Zealand Clinical Trials Registry ACTRN12618002026202 ; 18/12/2018.

PMID: 36593455

19. Evaluation of Dysphagia and Inhalation Risk in Neurologically Impaired Children Using Esophageal High-Resolution Manometry with Swallowing Analysis
Anna Maria Caruso, Denisia Bommarito, Vincenza Girgenti, Glenda Amato, Adele Figuccia, Alessandra Casuccio, Annalisa Ferlisi, Rosaria Genuardi, Sabrina La Fata, Rosalia Mattei, Mario Pietro Marcello Milazzo, Maria Rita Di Pace

Children (Basel). 2022 Dec 17;9(12):1987. doi: 10.3390/children9121987.

Background: Dysphagia in neurologically impaired children is associated with feeding difficulties, malnutrition and aspiration pneumonia. Esophageal high-resolution manometry (HRM) has been used in the diagnosis of motility disorders affecting the swallowing process. The aim of this study was to analyze swallowing functions in NI children by using HRM in order to establish swallow parameters identifying inhalation risk. Methods: Twenty-five NI children with cerebral palsy were submitted to esophageal HRM with UES analysis, comparing the results with non-NI children. The following parameters were evaluated: maximum pressure and duration of contraction of the velopharynx (VP) and tongue base (TB), and maximal, minimal, resting

pressure and relaxation duration of the upper esophageal sphincter (UES). Results: pVP max, pTB max, pUES max and resting pressure were lower, while p UES minimal was higher and relaxation duration was shorter in NI children vs. the control group. Predictive values of inhalation risk were evaluated. Conclusions: This study evaluates inhalation risk in NI children using HRM to study UES function. Our results confirm the alterations described in NI children: insufficient contraction and clearing force for bolus transmission through the pharynx and incomplete UES relaxation can predispose to pharyngeal residues and inhalation independently of swallowing because of lower values of UES resting.

PMID: 36553430

20. Evaluation of the Effectiveness of Functional Chewing Training Compared with Standard Treatment in a Population of Children with Cerebral Palsy: A Systematic Review of Randomized Controlled Trials
Alessandra Banzato, Antonella Cerchiari, Sofia Pezzola, Michela Ranucci, Eleonora Scarfò, Anna Berardi, Marco Tofani, Giovanni Galeoto

Review Children (Basel). 2022 Nov 30;9(12):1876. doi: 10.3390/children9121876.

Background: Functional Chewing Training (FuCT) was designed as a holistic approach to improve chewing function by providing postural alignment, sensory and motor training, and food and environmental adjustments. The aim of this systematic review was to evaluate the effectiveness of FuCT in improving chewing function and the severity of tongue thrust and drooling in children with cerebral palsy as compared with standard treatment. Methods: We conducted a systematic review of randomized controlled trials. The search was performed between October 2021 and January 2022 using the following databases: PubMed, Scopus, Web of Science, and CINAHL. The review was performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Results: The initial search yielded 56 articles. After reading the studies in full, 3 articles were chosen based on the inclusion criteria. Included participants were people with PCI; the studies reported a sample size ranging from 40-80 individuals, one study was on a pediatric population, while the others on adults. The selected studies were then evaluated using Jadad and PEDro scales. Conclusion: Our study confirmed the value of FuCT in improving chewing function and the severity of tongue thrust and drooling. Our results may be useful in optimizing appropriate therapeutic management.

PMID: 36553319

21. A Review of Food Texture Modification among Individuals with Cerebral Palsy: The Challenges among Cerebral Palsy Families
Sakinah Kamal, Sazlina Kamaralzaman, Shobha Sharma, Nurul Hazirah Jaafar, Phei Ming Chern, Nurul Izzaty Hassan, Hasnah Toran, Noor Akmal Shareela Ismail, Ghazali Yusri, Nur Hana Hamzaid

Review Nutrients. 2022 Dec 9;14(24):5241. doi: 10.3390/nu14245241.

Individuals with cerebral palsy (CP) frequently present with multiple feeding problems, which may require food texture modification to ensure safe feeding. This review aims to explore the challenges individuals with CP and their caregiver's face and recommend modified food textures to ensure safety and improve the quality of life and nutritional status. A systematic search was carried out through four databases (i.e., EBSCO (Medline), PubMed, Science Direct, and Web of Science) between January 2011 and May 2022. Out of 86 articles retrieved, seven were selected based on keywords and seven other studies through manual search-five cross-sectional studies, two qualitative studies, one correlational study, one mixed method study, one case-control study, two sections of books, and two educational materials. The findings suggest that preparation and intake of food with modified texture play a necessary role in the safety of swallowing in addition to physical, social, and environmental aspects. Safety was found to be the crucial part of the food texture modification provision besides considering the stress of the caregivers and the nutritional status of individuals with CP. Currently, there are no standard guidelines available pertaining to food texture modification. This led to uncertainties in the dietary provision among caregivers, which may lead to undernourishment. Hence, standard guidelines relating to food texture modification that focuses on food preparation and menus with calorie and nutrient information are timely to be developed.

PMID: 36558401

22. Investigating language, social cognition, and executive function in cerebral palsy outcomes
Paul Eslinger

Dev Med Child Neurol. 2022 Dec 23. doi: 10.1111/dmcn.15483. Online ahead of print.

No abstract available

PMID: 36562336

23. Determinants of Quality of Life of Children and Adolescents with Cerebral Palsy: A Systematic Review
Nihad A Almasri, Fatima Alzahra Alquaqzeh

Phys Occup Ther Pediatr. 2023 Jan 1;1-22. doi: 10.1080/01942638.2022.2162358. Online ahead of print.

Objective: To summarize research findings on the determinants of Quality of Life (QoL) in children with cerebral palsy based on the International Classification of Functioning, Disability, and Health (ICF). Methods: The protocol of the review was registered in the International Prospective Register of The Systematic Reviews PROSPERO (CRD42021261966). A PubMed, Web of Science, MEDLINE complete, and CINAHL Plus search was conducted between January 2020 and October 2021 to identify studies that examined determinants of QoL. Inclusion criteria for the studies were children between the ages of birth and 20 years with cerebral palsy. The data extraction and quality evaluation of studies were carried out independently by two reviewers. Results: A total of 664 studies were identified in the search, of which 23 studies were included in the review. The majority of the studies were conducted in high-income countries. According to the ICF, 48% of the studies examined body function determinants, 52% examined activities determinants, and 26% examined environmental determinants. In contrast, 13% of the studies examined determinants related to participation and 13% examined determinants related to personal factors. Conclusions: Based on our findings, most of the determinants identified in the literature are related sequentially to functional activities, body functions and structures, and environmental factors. Researchers should focus on assessing the determinants of QoL related to participation and personal characteristics for children with cerebral palsy in order to improve their QoL.

PMID: 36588347

24. Parent-report health-related quality of life in school-aged children with cerebral palsy: A cross-sectional study
Fábio Vila-Nova, Sofia Santos , Raul Oliveira, Rita Cordovil

Front Rehabil Sci. 2022 Dec 5;3:1080146. doi: 10.3389/fresc.2022.1080146. eCollection 2022.

Quality of life is both a goal and an outcome in Cerebral Palsy (CP) rehabilitation. Children with CP may show impaired health -related quality of life (HRQoL) compared to their typical peers. Parents' perceptions of HRQoL of their children could help rehabilitation professionals to identify areas for intervention aiming to improve health and wellbeing. This study aims to compare the proxy HRQoL of Portuguese school-aged children with CP and the general population, and to analyze child and family correlation. Differences were examined using European normative data for children from 8 to 18 years. Correlation and regression analysis examined the association between child and family variables in the CP group with statistically significant low scores. Sixty-eight parents of children and adolescents with CP (12.5 ± 2.91 years) answered the KIDSCREEN-52 parent version. We identified clinically significantly lower HRQoL in four out of ten HRQoL domains (Physical well-being, Autonomy, Moods & Emotions, and Bullying) than the norm peers. Correlations were found between the number of siblings and Autonomy ($r = .315$), meaning that having more siblings was associated with greater autonomy, and between mobility and Moods & Emotions ($r = -.261$), where children with impaired mobility shown low scores as perceived by their parents. Age, sex, mobility and cognitive impairment explained 32% of Physical well-being scores ($p < .001$). Mobility and cognitive impairment explained 16% of Bullying scores ($p = .001$). Although the family and child variables identified in this study are non-modifiable, they can help in the identification and early intervention aimed at improving HRQoL. Rehabilitation professionals should assess parent perceptions, extending the HRQoL assessment to children who can report and other informants, aiming at fostering wellbeing in children and adolescents with CP.

PMID: 36561730

25. Effectiveness of Mechanical Horse-Riding Simulator-Based Interventions in Patients with Cerebral Palsy-A Systematic Review and Meta-Analysis
Esteban Obrero-Gaitán, Desirée Montoro-Cárdenas, Irene Cortés-Pérez, María Catalina Osuna-Pérez

Review Bioengineering (Basel). 2022 Dec 11;9(12):790. doi: 10.3390/bioengineering9120790.

Background: Mechanical horse-riding simulator (HRS) exercises are a type of therapy based on the use of robotic or mechanical devices that produces movement similar to a real horse with the aim of simulating hippotherapy. This review analyses the effectiveness of HRS therapies in patients with cerebral palsy (CP). Methods: A systematic review and a meta-analysis were carried out by searching studies in PubMed Medline, SCOPUS, Web of Science, CINAHL, PEDro and SciELO up until October 2022. We selected clinical trials that assessed the effectiveness of HRS therapy, compared to other interventions, in patients with CP. The main variables were gross motor function (its global score and dimensions, such as sitting ability), functional balance, spasticity, hip range of motion (ROM), posturographic balance and satisfaction. The risk of bias was assessed using the Cochrane Risk of Bias Tool. The pooled effect was calculated using Cohen's Standardized Mean Difference (SMD) for a 95% confidence interval (95% CI). Results: Twelve studies were included in the systematic review, and 10 were included in the meta-analysis, providing data from 343 patients with spastic diplegic CP. Our findings revealed that HRS plus physiotherapy is more effective than physiotherapy in improving the total gross motor function (SMD 0.98; 95% CI 0.35-1.62), sitting ability of the gross motor function (SMD 0.84; 95% CI 0.32-1.36) and functional balance (SMD 0.6; 95% CI 0.1-1.08), and HRS therapy is better than sham to improve pelvic abduction ROM (SMD 0.79; 95% CI 0.21-1.37). Conclusions: Horse-riding simulator-based therapy is an effective therapy to improve gross motor function, functional balance and abduction pelvic ROM in children with CP, in comparison to physiotherapy or sham.

PMID: 36550996

26. Analysis of trunk muscles activity during horseback riding machine exercise in children with spastic cerebral palsy
Kyeongbong Lee, JungHee Jung, HyeonHui Shin, GyuChang Lee

Medicine (Baltimore). 2022 Dec 30;101(52):e31915. doi: 10.1097/MD.0000000000031915.

Appropriate trunk muscle activity is needed to perform functional activities in cerebral palsy, this study analyzed the activity of trunk muscles during horseback riding machine exercise in children with spastic cerebral palsy. 10 children with spastic cerebral palsy were participated, the activity of the trunk muscles, including both sides of the rectus abdominis, external oblique, latissimus dorsi, and erector spinae in sitting posture and during horseback riding machine exercise were evaluated using a surface electromyography. The activity of bilateral rectus abdominis, external oblique, latissimus dorsi, and erector spinae increased during horseback riding machine exercise than quiet sitting posture. Moreover, there were significant differences in activities of the trunk muscles between the sitting posture and horseback riding machine exercise, with the exception of the left external oblique and the left latissimus dorsi. Horseback riding machine exercise provides more opportunities to use the trunk muscles for children with spastic cerebral palsy than general sitting posture. In future, it will be of use to investigate the effect of horseback riding machine exercise in patients with cerebral palsy.

PMID: 36595990

27. Efficacy of Robot-Assisted Gait Therapy Compared to Conventional Therapy or Treadmill Training in Children with Cerebral Palsy: A Systematic Review with Meta-Analysis
Irene Cortés-Pérez, Noelia González-González, Ana Belén Peinado-Rubia, Francisco Antonio Nieto-Escamez, Esteban Obrero-Gaitán, Héctor García-López

Review Sensors (Basel). 2022 Dec 16;22(24):9910. doi: 10.3390/s22249910.

Background: Motor, gait and balance disorders reduce functional capabilities for activities of daily living in children with cerebral palsy (CP). Robot-assisted gait therapy (RAGT) is being used to complement conventional therapy (CT) or treadmill therapy (TT) in CP rehabilitation. The aim of this systematic review is to assess the effect of RAGT on gait, balance and functional independence in CP children, in comparison to CT or TT. Methods: We have conducted a systematic review with

meta-analysis. A search in PubMed Medline, Web of Science, Scopus, CINAHL, PEDro and SciELO has been conducted for articles published until October 2022. Controlled clinical trials (CCT), in which RAGT was compared to TT or CT and assessed gait speed, step and stride length, width step, walking distance, cadence, standing ability, walking, running and jumping ability, gross motor function and functional independence in children with CP, have been included. Methodological quality was assessed with the PEDro scale and the pooled effect was calculated with Cohen's Standardized Mean Difference (SMD) and its 95% Confidence Interval (95% CI). Results: A total of 15 CCTs have been included, providing data from 413 participants, with an averaged methodological quality of 5.73 ± 1.1 points in PEDro. The main findings of this review are that RAGT shows better results than CT in the post-intervention assessment for gait speed (SMD 0.56; 95% CI 0.03 to 1.1), walking distance (SMD 2; 95% CI 0.36 to 3.65) and walking, running and jumping ability (SMD 0.63; 95% CI 0.12 to 1.14). Conclusions: This study shows that the effect of RAGT is superior to CT on gait speed, walking distance and walking, running and jumping ability in post-intervention, although no differences were found between RAGT and TT or CT for the remaining variables.

PMID: 36560281

28. Use of Robot-Assisted Gait Training in Pediatric Patients with Cerebral Palsy in an Inpatient Setting-A Randomized Controlled Trial
Fabian Moll, Axel Kessel, Anna Bonetto, Johanna Stresow, Monika Herten, Marcel Dudda, Jens Adermann

Randomized Controlled Trial Sensors (Basel). 2022 Dec 16;22(24):9946. doi: 10.3390/s22249946.

Robot-assisted gait training (RAGT) provides a task-based support of walking using exoskeletons. Evidence shows moderate, but positive effects in the therapy of patients with cerebral palsy (CP). This study investigates the impact of RAGT on walking speed and gait parameters in pediatric CP patients. Thirty subjects (male = 23; female = 7), with a mean age of 13.0 ± 2.5 (9-17) years, and with spastic CP, were recruited. The intervention group (n = 15) underwent six 20-minute RAGT sessions with the Hybrid Assistive Limb (HAL) during an 11-day hospital stay. Additionally, a therapy concept including physiotherapy, physician-performed manual medicine, massage and exercise therapy was provided. The control group (n = 15) was treated with the therapy concept only. The outcome was based on a 10-Metre Walking Test (10MWT), 6-Minute Walking Test (6MWT), Gross Motor Function Measure (GMFM-88) and lower extremities passive range of motion. The intervention group achieved a mean increase in walking speed in the 10MWT (self-selected walking speed SSW) of 5.5 s ($p = 0.378$). There were no significant differences between the groups in the 10MWT (max) ($p = 0.123$) and the 6MWT ($p = 0.8$). Changes in the GMFM (total) and in the dimension standing and walking, running and jumping (D + E) showed clinically relevant significant results ($p = 0.002$ and $p = 0.046$). RAGT as a supplement to an inpatient therapy stay appears to have a positive, yet not significant impact on the gait parameters of pediatric CP patients as well as motivating them to practice walking. Further studies with adapted study designs are needed to evaluate different influencing factors.

PMID: 36560316

29. Association of Race With Post-operative Complications After Spinal Fusion in Children With Cerebral Palsy
Lauryn Brown, Denver Kraft, Aribah Shah, Christian Falgons, Theodore Quan, Alisa Malyavko, Sean Tabaie

Cureus. 2022 Dec 25;14(12):e32920. doi: 10.7759/cureus.32920. eCollection 2022 Dec.

Introduction: Neuromuscular scoliosis in children with cerebral palsy (CP) can lead to debilitating difficulties with pain, ambulation, sitting, and respiratory or cardiac compromise. Spinal fusion can halt deformity progression, though the decision to undergo surgery involves an individualized risk-benefit assessment. The purpose of this study was to evaluate whether race is a risk factor for patients with CP to experience post-operative complications after spinal fusion. Methods: This is a retrospective cohort analysis of a national database. Analyses methods include univariate analyses, multivariate regression models, and other ad-hoc tests. Results: There were 3,081 pediatric patients with CP who underwent spinal fusion. Black patients had an increased risk of experiencing any post-operative complication compared to Caucasians (OR 1.322, 95% CI 1.099-1.590). Both Caucasian($p=0.005$) and Black ($p<0.001$) races were risk factors for experiencing medical complications; Black patients had an increased risk compared to Caucasians (OR 1.373, 95% CI 1.130-1.667). Other races had a greater length of ICU stay than Caucasians (median {Mdn}=3.00 days vs Mdn=2.00, $p=0.029$), and longer total hospital stays than Caucasian and Black patients (Mdn=9.00 days vs Mdn=6.00 days vs Mdn=6.00 days, $p<0.001$). Conclusion: Race is an independent risk factor for pediatric patients with CP to experience medical complications following spinal fusion surgery, with Black patients having an increased risk compared to Caucasians. Further, other races were found to have significantly longer ICU and total hospital

length of stay. This study is the first to present race as a risk factor for children with CP to experience increased post-operative complications following spinal fusion and will be valuable in understanding their individualized peri-operative courses and risks.

PMID: 36578858

30. Identifying Children With Medical Complexity for Care Coordination in Primary Care Settings
Mikayla Burrell, Mary Ciccarelli

Clin Pediatr (Phila). 2022 Dec 29;99228221144803. doi: 10.1177/00099228221144803. Online ahead of print.

Characteristics of a cohort of 98 children with medical complexity (CMC) insured by Medicaid were identified within an urban/rural pediatric practice for embedded nurse care coordination. Ninety percent of enrolled children fit the predefined requirements of requiring 3 or more subspecialists for their care. Neurology, orthopedic surgery, endocrinology, and gastroenterology were the most frequent subspecialists engaged in longitudinal care. The expected neurodevelopmental disabilities (cerebral palsy, spina bifida, Down syndrome, and other complex syndromes) were found in 64% of the patients. By applying a secondary definition to include children with complex neurodevelopmental or genetic syndromes, 98% of the patients were considered to be medically complex. The use of reliable and adequate criteria to identify medical complexity is important to determine which patients would most benefit from care coordination services, and our method was deemed successful.

PMID: 36579852

31. Oral health status and barriers to oral healthcare among children with cerebral palsy attending a health care center in Kampala, Uganda
S M Kachwinya, A M Kemoli, R Owino, I Okullo, J Bermudez, A L Seminario

BMC Oral Health. 2022 Dec 30;22(1):656. doi: 10.1186/s12903-022-02677-2.

Background: Cerebral palsy (CP) is a non-progressive neuromuscular condition diagnosed in childhood. CP as a form of disability, does not cause any specific oral disease. However, some oral conditions are more commonly associated with people with CP compared to the general population. The overarching aim of the current study was to determine the oral hygiene status, gingival status, and the prevalence of dental caries in children with CP attending a leading hospital institution for children with disabilities in Kampala, Uganda. Additionally, we determined the barriers faced by children with CP in accessing oral healthcare. Methods: This cross-sectional study was carried out at the Comprehensive Rehabilitation Services Uganda hospital in Kampala, Uganda. Our study population consisted of a convenient sample of 90 children diagnosed with CP aged 3-17 years and their caregivers. A validated and interviewer administered structured questionnaire was used to collect socio-demographic data of the participants. A modified World Health Organization oral health assessment form for those aged 3-17 years was used to gather data on oral health status (plaque score, gingival bleeding and dental caries.) The data was subjected to statistical tests with critical value set up at 5%. Results: Only 32.2% of the children evaluated had adequate oral hygiene, while 44.4% of the children experienced gingival bleeding. The prevalence of dental caries for both deciduous and permanent dentition was 63.3%, with DMFT values of 3.8 ± 4.5. The most common barrier reported by the caregivers was the challenge in modality of transportation availability from the children's homes to the health facilities (34.4%). Conclusions: Children with CP in the study population have a significant prevalence of oral diseases and face several barriers to oral healthcare. Results from this study aim to provide relevant support to advocate for a nationwide change in policy to improve access to dental care to decrease the burden of oral diseases in children with special healthcare needs.

PMID: 36585679

32. Quality of life and its predicting factors for Tunisian children with cerebral palsy
Ghanmi Marwa, Sahbi Mtawaa, Emna Toulgui, Rihab Moncer, Walid Wannes, Khaled Maaref, Sonia Jemni

Afr J Disabil. 2022 Dec 15;11:1046. doi: 10.4102/ajod.v11i0.1046. eCollection 2022.

Background: Cerebral palsy (CP) can cause motor, sensory, perceptual, cognitive, communication and behavioural disorders. The complexity of this condition justifies measuring the quality of life (QOL) of children with CP. This measurement depends on personal and socio-economic factors, hence the relevance of performing it in our cultural context of Tunisia. Objectives: The objectives of this study were to assess the QOL of Tunisian children with CP and to identify predictive factors for QOL. Method: A cross-sectional study using a self-administered questionnaire (the CP QOL-Child) was employed. It included 68 children with CP and their parents who consulted the outpatient clinics of Physical Medicine and Rehabilitation of the University Hospital of Sahloul Sousse. Results: The QOL of children with CP was altered, and the mean total score for the CP QOL-Child was 59.3 (± 14). All domains were affected by this alteration. Six predictive factors for lowered QOL in children with CP were identified, namely age older than 6 years, swallowing disorders, more intense chronic pain, greater level of motor impairment, the use of botulinum toxin injection and the absence of verbal communication. Conclusion: Intervention with children with CP must be mindful of their altered QOL. Five out of the six predictive factors of QOL are modifiable through a multidisciplinary approach within the framework of the International Classification of Functioning, Disability and Health (ICF). Contribution: The multiplicity of the factors associated with QOL revealed by this study incites clinicians to adopt the ICF approach by displaying its practical implications on the efficiency of the medical intervention.

PMID: 36567926

33. Level of Awareness and Attitude Toward Cerebral Palsy Among Parents in Al-Baha City, Saudi Arabia
Elfatih M Salih, Saleem A Alghamdi, Rayan A Alghamdi, Mohannad S Alghamdi, Turki A Alzahrani

Cureus. 2022 Nov 22;14(11):e31791. doi: 10.7759/cureus.31791. eCollection 2022 Nov.

Background Cerebral palsy (CP) is a chronic disorder of motion, posture, and tone which occurs due to brain insult during the period of brain growth. It is a disabling disorder in both motor and intellectual aspects. Fortunately, CP is a manageable disease that can be managed in part by increasing the knowledge and understanding of the parents. Methodology This cross-sectional, prospective, community-based study aimed to assess the level of parents' knowledge and their attitude toward CP using an electronic questionnaire. The parents' knowledge was classified as good or poor based on an adopted scoring system. The parents' attitude was categorized as positive or negative. Results Our study results showed that good knowledge (those with a score more than 60% of the total score) was noted in 275 (61.1%) participants, whereas 175 of the participants had poor knowledge (38.9%), especially regarding awareness of the diagnosis of CP. Conclusions Most participants had an overall good knowledge of CP although they had insufficient knowledge of some aspects of the disease such as causes, disease course, clinical presentations, diagnosis, and prognosis. Although the results showed a positive attitude concerning playing with a child with CP, unfortunately, there was a negative attitude toward hiring a CP patient and a strongly negative attitude toward marrying a patient with CP.

PMID: 36569676

34. DNA Methylation Analysis Reveals Distinct Patterns in Satellite Cell-Derived Myogenic Progenitor Cells of Subjects with Spastic Cerebral Palsy
Karyn G Robinson, Adam G Marsh, Stephanie K Lee, Jonathan Hicks, Brigette Romero, Mona Batish, Erin L Crowgey, M Wade Shrader, Robert E Akins

J Pers Med. 2022 Nov 30;12(12):1978. doi: 10.3390/jpm12121978.

Spastic type cerebral palsy (CP) is a complex neuromuscular disorder that involves altered skeletal muscle microanatomy and growth, but little is known about the mechanisms contributing to muscle pathophysiology and dysfunction. Traditional genomic approaches have provided limited insight regarding disease onset and severity, but recent epigenomic studies indicate that DNA methylation patterns can be altered in CP. Here, we examined whether a diagnosis of spastic CP is associated with intrinsic DNA methylation differences in myoblasts and myotubes derived from muscle resident stem cell populations (satellite cells; SCs). Twelve subjects were enrolled (6 CP; 6 control) with informed consent/assent. Skeletal muscle biopsies were obtained during orthopedic surgeries, and SCs were isolated and cultured to establish patient-specific myoblast cell lines capable of proliferation and differentiation in culture. DNA methylation analyses indicated significant differences at 525 individual CpG sites in proliferating SC-derived myoblasts (MB) and 1774 CpG sites in differentiating SC-derived myotubes (MT). Of these, 79 CpG sites were common in both culture types. The distribution of differentially methylated 1 Mbp chromosomal segments indicated distinct regional hypo- and hyper-methylation patterns, and significant enrichment of

differentially methylated sites on chromosomes 12, 13, 14, 15, 18, and 20. Average methylation load across 2000 bp regions flanking transcriptional start sites was significantly different in 3 genes in MBs, and 10 genes in MTs. SC derived MBs isolated from study participants with spastic CP exhibited fundamental differences in DNA methylation compared to controls at multiple levels of organization that may reveal new targets for studies of mechanisms contributing to muscle dysregulation in spastic CP.

PMID: 36556199

35. Prevalence and Implications of Low Reticulocyte-Hemoglobin Levels among Extreme Preterm Neonates: A Single-Center Retrospective Study
Jhanahan Sriranjan, Christine Kalata, Gerhard Fusch, Karen Thomas, Ipsita Goswami

Nutrients. 2022 Dec 16;14(24):5343. doi: 10.3390/nu14245343

This retrospective cohort study aims to determine the epidemiology of iron deficiency among extreme preterm neonates and the association of iron-deficient status during the NICU stay with neurodevelopmental outcomes at 18-24 months. Neonates ≤29 weeks gestational age (GA) born between June 2016 and December 2019, who received routine iron supplementation were enrolled. Iron deficiency was defined as reticulocyte-hemoglobin (Ret-Hb) levels ≤ 29 pg at 36 weeks corrected age. A subcohort of neonates completed standardized developmental assessment at 18-24 months corrected age. Significant neurodevelopmental impairment (sNDI) was defined as either Bayley Scales of Infant Development score < 70 or cerebral palsy or blindness or hearing aided. Among a cohort of 215 neonates [GA 25.8 (1.7) weeks, birthweight 885 (232) g], prevalence of iron deficiency was 55%, 21%, 26%, and 13%, in neonates <24 weeks, 24-25 + 6 weeks, 26-27 + 6 weeks, and ≥ 28 weeks GA, respectively. Male sex and receipt of corticosteroid therapy were associated with iron-deficiency. In the subcohort analysis (n = 69), there was no statistically significant association between Ret-Hb levels at 36 weeks corrected age and the risk of sNDI [OR 0.99 (95% CI 0.85-1.2)]. Male infants and those who received postnatal corticosteroids are likely to have iron-limited erythropoiesis at corrected term despite routine iron-supplementation; however, low Ret-Hb levels during the neonatal period were not associated with significant neurological disability in early childhood.

PMID: 36558502

36. GSDMD deficiency ameliorates hyperoxia-induced BPD and ROP in neonatal mice
Sarah Sonny, Huijun Yuan, Shaoyi Chen, Matthew R Duncan, Pingping Chen, Merline Benny, Karen Young, Kevin K Park, Augusto F Schmidt, Shu Wu

Sci Rep. 2023 Jan 4;13(1):143. doi: 10.1038/s41598-022-27201-y.

Bronchopulmonary dysplasia (BPD) and retinopathy of prematurity (ROP) are among the most common morbidities affecting extremely premature infants who receive oxygen therapy. Many clinical studies indicate that BPD is associated with advanced ROP. However, the mechanistic link between hyperoxia, BPD, and ROP remains to be explored. Gasdermin D (GSDMD) is a key executor of inflammasome-induced pyroptosis and inflammation. Inhibition of GSDMD has been shown to attenuate hyperoxia-induced BPD and brain injury in neonatal mice. The objective of this study was to further define the mechanistic roles of GSDMD in the pathogenesis of hyperoxia-induced BPD and ROP in mouse models. Here we show that global GSDMD knockout (GSDMD-KO) protects against hyperoxia-induced BPD by reducing macrophage infiltration, improving alveolarization and vascular development, and decreasing cell death. In addition, GSDMD deficiency prevented hyperoxia-induced ROP by reducing vasoobliteration and neovascularization, improving thinning of multiple retinal tissue layers, and decreasing microglial activation. RNA sequencing analyses of lungs and retinas showed that similar genes, including those from inflammatory, cell death, tissue remodeling, and tissue and vascular developmental signaling pathways, were induced by hyperoxia and impacted by GSDMD-KO in both models. These data highlight the importance of GSDMD in the pathogenesis of BPD and ROP and suggest that targeting GSDMD may be beneficial in preventing and treating BPD and ROP in premature infants.

PMID: 36599874

37. Early predictors of neurodevelopment after perinatal arterial ischemic stroke: a systematic review and meta-analysis
Lisanne M Baak, Niek E van der Aa, Annemijn A E Verhagen, Jeroen Dudink, Floris Groenendaal, Cora H A Nijboer, Manon J N L Benders, Nienke Wagenaar

Pediatr Res. 2022 Dec 27. doi: 10.1038/s41390-022-02433-w. Online ahead of print.

Background and aims: Perinatal arterial ischemic stroke (PAIS) often has lifelong neurodevelopmental consequences. We aimed to review early predictors (<4 months of age) of long-term outcome. Methods: We carried out a systematic literature search (PubMed and Embase), and included articles describing term-born infants with PAIS that underwent a diagnostic procedure within four months of age, and had any reported outcome parameter ≥12 months of age. Two independent reviewers included studies and performed risk of bias analysis. Results: We included 41 articles reporting on 1395 infants, whereof 1255 (90%) infants underwent follow-up at a median of 4 years. A meta-analysis was performed for the development of cerebral palsy (n = 23 studies); the best predictor was the qualitative or quantitative assessment of the corticospinal tracts on MRI, followed by standardized motor assessments. For long-term cognitive functioning, bedside techniques including (a)EEG and NIRS might be valuable. Injury to the optic radiation on DTI correctly predicted visual field defects. No predictors could be identified for behavior, language, and post-neonatal epilepsy. Conclusion: Corticospinal tract assessment on MRI and standardized motor assessments are best to predict cerebral palsy after PAIS. Future research should be focused on improving outcome prediction for non-motor outcomes. Impact: We present a systematic review of early predictors for various long-term outcome categories after perinatal arterial ischemic stroke (PAIS), including a meta-analysis for the outcome unilateral spastic cerebral palsy. Corticospinal tract assessment on MRI and standardized motor assessments are best to predict cerebral palsy after PAIS, while bedside techniques such as (a)EEG and NIRS might improve cognitive outcome prediction. Future research should be focused on improving outcome prediction for non-motor outcomes.

PMID: 36575364

38. Therapeutic hypothermia is associated with changes in prognostic value of general movements
Fabrizio Ferrari, Luca Bedetti, Francesca Cavalleri, Laura Lucaccioni, Natascia Bertoncelli, Isotta Guidotti, Licia Lugli, Maria Federica Roversi, Elisa Della Casa Muttini, Marisa Pugliese, Elena Arpi, Roberto D'Amico, Alberto Berardi

Eur J Paediatr Neurol. 2022 Dec 16;42:53-59. doi: 10.1016/j.ejpn.2022.12.004. Online ahead of print.

Background and aims: General movements (GMs) have been recognized as the most accurate clinical tools for predicting cerebral palsy (CP). This study aimed to compare the type and prognostic value of abnormal GMs in infants with hypoxic ischemic encephalopathy treated or not with therapeutic hypothermia (TH). Materials and methods: This was a single-center retrospective study. We compared GMs of 55 cooled term infants versus 30 non-cooled term infants with hypoxic ischemic encephalopathy (HIE) and their motor outcome at 24 months of age. We also included data regarding early brain MRI scans. Results: Rates of cerebral palsy was 5.4% and 46.7% in cooled and non-cooled infants respectively ($p < 0.001$). None of cooled infants showed cramped-synchronized GMs, whereas among non-cooled infants the cramped-synchronized pattern was present in 17.2% and 20% of infants at 1 and 3 months of age respectively. Hypokinesis was never seen in cooled infants and it was present in 23.3% of non-cooled ones. Absent fidgety correlated with CP in 14% and 73% of cooled and non-cooled infants respectively. At brain MRI cooled infants had fewer and less severe cerebral lesions compared to non-cooled infants ($p = 0.003$). Conclusions: Abnormal GMs are reduced in infants treated with TH. Hypokinesis and cramped-synchronized GMs are not observed in cooled infants and the associations between absent fidgety movements and CP it is largely abolished. TH is associated with changes in prognostic value of GMs.

PMID: 36563466

39. Outcome at early school age and adolescence after hypothermia-treated hypoxic-ischaemic encephalopathy: an observational, population-based study
Katarina Robertsson Grossmann, Mimmi Eriksson Westblad, Mats Blennow, Katarina Lindström

Arch Dis Child Fetal Neonatal Ed. 2022 Dec 9;fetalneonatal-2022-324418. doi: 10.1136/archdischild-2022-324418. Online ahead of print.

Objective: We aimed to describe long-term outcomes following hypoxic-ischaemic encephalopathy (HIE) treated with therapeutic hypothermia (TH). Design: Prospective, population-based observational study. Setting: Tertiary level neonatal intensive care units and neonatal outpatient clinic, Karolinska University Hospital, Stockholm, Sweden. Patients: Sixty-six infants treated with TH due to HIE between 2007 and 2009. Interventions: At 6-8 years and 10-12 years of age, children were assessed using a standardised neurological examination, the Movement Assessment Battery for Children, Second Edition (MABC-2) and the Wechsler Intelligence Scales for Children IV/V. Parents completed the Five-to-Fifteen (FTF) questionnaire. Main outcome measures: Adverse outcome among survivors was defined as cerebral palsy (CP), epilepsy, hearing or visual impairment, full-scale IQ (FSIQ) below 85, attention deficit disorder with/without hyperactivity, autism spectrum disorder or developmental coordination disorder. Results: Mortality was 12%. Seventeen per cent of survivors developed CP. Mean FSIQ was normal in children without major neuromotor impairment. Assessment in early adolescence revealed emerging deficits in 26% of children with a previously favourable outcome. The proportion of children exhibiting executive difficulties increased from 7% to 19%. This was reflected also by a significantly increased proportion of children with an FTF score >90th percentile compared with norms in early adolescence. The proportion of children with an MABC-2 score ≤5th percentile was also significantly increased compared with norms. Conclusions: Survivors without major neuromotor impairment have normal intelligence. The incidence of executive difficulties appears to be increased in this patient population. More subtle difficulties may go undetected at early school-age.

PMID: 36600485

40. The role of early functional neuroimaging in predicting neurodevelopmental outcomes in neonatal encephalopathy
Carla R Pinto, João V Duarte, Carla Marques, Inês N Vicente, Catarina Paiva, João Éloi, Daniela J Pereira, Bárbara R Correia, Miguel Castelo-Branco, Guiomar Oliveira

Eur J Pediatr. 2023 Jan 6. doi: 10.1007/s00431-022-04778-0. Online ahead of print.

Reliably assessing the early neurodevelopmental outcomes in infants with neonatal encephalopathy (NE) is of utmost importance to advise parents and implement early and personalized interventions. We aimed to evaluate the accuracy of neuroimaging modalities, including functional magnetic resonance imaging (fMRI) in predicting neurodevelopmental outcomes in NE. Eighteen newborns with NE due to presumed perinatal asphyxia (PA) were included in the study, 16 of whom underwent therapeutic hypothermia. Structural magnetic resonance imaging (MRI), and fMRI during passive visual, auditory, and sensorimotor stimulation were acquired between the 10th and 14th day of age. Clinical follow-up protocol included visual and auditory evoked potentials and a detailed neurodevelopmental evaluation at 12 and 18 months of age. Infants were divided according to sensory and neurodevelopmental outcome: severe, moderate disability, or normal. Structural MRI findings were the best predictor of severe disability with an AUC close to 1.0. There were no good predictors to discriminate between moderate disability versus normal outcome. Nevertheless, structural MRI measures showed a significant correlation with the scores of neurodevelopmental assessments. During sensorimotor stimulation, the fMRI signal in the right hemisphere had an AUC of 0.9 to predict absence of cerebral palsy (CP). fMRI measures during auditory and visual stimulation did not predict sensorineural hearing loss or cerebral visual impairment. Conclusion: In addition to structural MRI, fMRI with sensorimotor stimulation may open the gate to improve the knowledge of neurodevelopmental/motor prognosis if proven in a larger cohort of newborns with NE. What is known: • Establishing an early, accurate neurodevelopmental prognosis in neonatal encephalopathy remains challenging. • Although structural MRI has a central role in neonatal encephalopathy, advanced MRI modalities are gradually being explored to optimize neurodevelopmental outcome knowledge. What is new: • Newborns who later developed cerebral palsy had a trend towards lower fMRI measures in the right sensorimotor area during sensorimotor stimulation. • These preliminary fMRI results may improve future early delineation of motor prognosis in neonatal encephalopathy.

PMID: 36607412

41. Body Composition and Spasticity in Children with Unilateral Cerebral Palsy-A Case-Control Study
Lawia Szkoda, Andrzej Szopa, Andrzej Siwiec, Ilona Kwiecień-Czerwieniec, Małgorzata Domagalska-Szopa

Children (Basel). 2022 Dec 5;9(12):1904. doi: 10.3390/children9121904.

The aim of this study was to identify the correlations between segmental body composition and the spasticity level of the affected lower limb in children with unilateral cerebral palsy (spastic hemiplegia). Additionally, an attempt was made to identify the differences in composition between the affected and unaffected lower limbs using segmental body composition analysis. This case-control study included 31 children with spastic hemiplegia aged 8 to 16 years with differing severities of

spasticity in the lower limbs. The reference group consisted of a control group which included 31 peers with corresponding age and sex to the tested group. Negative correlations obtained in the statistical analysis showed that higher spasticity level in the iliopsoas muscle is associated with lower limb fat-free mass and lower limb muscle mass. Our results showed that children with spastic hemiplegia have worse parameters of body composition in the affected limb than in the unaffected one. To confirm the importance of these results, further studies are needed in a larger population which includes non-ambulatory children.

PMID: 36553347

42. Bradykinesia assessment in children with cerebral palsy and periventricular leukomalacia
Chrysa Outsika, Kostalas Vangelis, Papadimitriou Ioanna, Kokkinou Eleftheria, Zouvelou Vasiliki, Dalivigka Zoi, Pons Roser

Eur J Paediatr Neurol. 2022 Dec 17;42:71-74. doi: 10.1016/j.ejpn.2022.11.008. Online ahead of print.

Objective: To analyse the motor phenotype with a focus on bradykinesia in children with Cerebral Palsy (CP) in the setting of periventricular leukomalacia (PVL). Methodology: Analysis of a cohort of 25 children with CP and PVL. The Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS) were used to classify the severity of motor function. Spasticity was rated using the Modified Ashworth Scale (MAS), dystonia was rated using the Burke -Fahn-Marsden Scale (BFMS), and bradykinesia was rated using the Unified Parkinson's disease rating scale (UPDRS). All patients were video-recorded following a standard protocol. Results: Bradykinesia was observed in 96% of patients. It was noted mainly in the limbs, and it was moderate-to-severe in the legs and mild-to-moderate in the arms. Bradykinesia correlated with functional level, as classified by GMFCS and MACS; also with dystonia, as rated by BFMS but did not correlate with a measure of spasticity (MAS). Conclusions: This study confirms the existence of bradykinesia in patients with CP in the setting of PVL. Bradykinesia and dystonia appear to be important interrelated factors influencing the level of gross and fine motor skills in patients with PVL.

PMID: 36580872

43. Prediction Model for Identifying Factors Associated with Epilepsy in Children with Cerebral Palsy
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Children (Basel). 2022 Dec 8;9(12):1918. doi: 10.3390/children9121918.

(1) Background: Cerebral palsy (CP) is associated with a higher incidence of epileptic seizures. This study uses a prediction model to identify the factors associated with epilepsy in children with CP. (2) Methods: This is a retrospective longitudinal study of the clinical characteristics of 102 children with CP. In the study, there were 58 males and 44 females, 65 inpatients and 37 outpatients, 72 had epilepsy, and 22 had intractable epilepsy. The mean age was 16.6 ± 1.2 years, and the age range for this study was 12-18 years. Data were collected on the CP etiology, diagnosis, type of epilepsy and spasticity, clinical history, communication abilities, behaviors, intellectual disability, motor function, and feeding abilities from 2005 to 2020. A prediction model, Epi-PredictMed, was implemented to forecast the factors associated with epilepsy. We used the guidelines of "Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis" (TRIPOD). (3) Results: CP etiology [(prenatal > perinatal > postnatal causes) p = 0.036], scoliosis (p = 0.048), communication (p = 0.018), feeding disorders (p = 0.002), poor motor function (p < 0.001), intellectual disabilities (p = 0.007), and the type of spasticity [(quadriplegia/triplegia > diplegia > hemiplegia), p = 0.002)] were associated with having epilepsy. The model scored an average of 82% for accuracy, sensitivity, and specificity. (4) Conclusion: Prenatal CP etiology, spasticity, scoliosis, severe intellectual disabilities, poor motor skills, and communication and feeding disorders were associated with epilepsy in children with CP. To implement preventive and/or management measures, caregivers and families of children with CP and epilepsy should be aware of the likelihood that these children will develop these conditions.

PMID: 36553361

44. Catatonia and neuroleptic malignant syndrome in patients with cerebral palsy: Two case reports and a systematic

review of the literature
Brian S Barnett, Dhiksha Balaji, Jeremy Weleff, Brendan T Carroll

Review J Acad Consult Liaison Psychiatry. 2022 Dec 28;S2667-2960(22)00627-9. doi: 10.1016/j.jaclp.2022.12.008. Online ahead of print.

Background: Patients with cerebral palsy, a group of movement disorders with motor, communication, and behavioral features that can mimic catatonic signs, could benefit from efforts to improve detection and treatment of comorbid catatonia. Given that cerebral palsy frequently co-occurs with conditions associated with catatonia such as autism spectrum disorder, epilepsy, intellectual disability, and mood and psychotic disorders, lifetime prevalence of catatonia in this population may be high. Objective: To systematically review the literature on catatonia and the related condition of neuroleptic malignant syndrome (NMS) in patients with cerebral palsy, while presenting two additional cases of catatonia. Methods: We used the terms "cerebral palsy" in combination with "catatoni*", related terms for catatonia, and "neuroleptic malignant syndrome" to query OVID Medline (1948 - November 28, 2022), PsycINFO, Cumulative Index to Nursing, and Allied Health Literature, and Embase for applicable case reports. The Neuroleptic Malignant Syndrome Information Service database was also manually searched. Results: In addition to our two catatonia reports, we identified ten reports of catatonia in patients with cerebral palsy, as well as eight reports of NMS. Patients with both conditions responded well and, sometimes rapidly, to treatment. Notably, of the five patients with catatonia and cerebral palsy who received electroconvulsive therapy (ECT), two developed recurrent self-limited hyperthermia post-treatment. We also identified several cases of baclofen withdrawal, which can be life threatening due to seizure risk, presenting with NMS-like features in patients with cerebral palsy who had malfunctioning intrathecal baclofen pumps for spasticity management. Conclusions: Given frequent comorbidity of conditions associated with catatonia in patients with cerebral palsy, as well as routine treatment with medications that can induce NMS, such as metoclopramide and anticholinergics, catatonia and NMS may be underreported in the cerebral palsy patient population, despite being highly treatable. Possible underdiagnosis of catatonia in patients with cerebral palsy may be due to misattribution of overlapping features between the two conditions to cerebral palsy. Clinicians should be aware of possible recurrent self-limited fever when employing ECT to treat patients with catatonia and cerebral palsy, while also being vigilant for intrathecal baclofen withdrawal when encountering NMS-like features in patients with cerebral palsy.

PMID: 36586471

45. Trajectories of medication use and polypharmacy among children with cerebral palsy
Jessica Pruente, Alecia K Daunter, Angeline Bowman, Steven R Erickson, Daniel Whibley, Daniel G Whitney

J Manag Care Spec Pharm. 2023 Jan;29(1):58-68. doi: 10.18553/jmcp.2023.29.1.58.

BACKGROUND: Children with cerebral palsy (CP) may have chronic exposure to polypharmacy to address several medical needs, but there is little research on the topic to inform surveillance methods and clinical practice. OBJECTIVE: To identify the trajectories of medication number and pediatric polypharmacy (≥2 concurrent medications) exposure over 3.5 years among children with CP. METHODS: This cohort study used commercial claims from January 1, 2015, to December 31, 2018 (4-year period). Children with CP, aged 5-18 years by January 1, 2016, and with continuous health plan enrollment for all 4 years, were included and categorized as with or without co-occurring neurological/ RESULTS: Of the 1,252 children with CP, 600 were in the CP only cohort (mean [SD]; age, 11.4 [4.1] years; 46.0% female) and 652 were in the CP + NDDs cohort (age, 11.9 [4.1] years; 41.3% female; 32.7% had ≥2 of the NDDs). For the primary GBTM, 3 trajectory groups were identified for CP only: on average, no prescribed medications (69.7% of the cohort), 1 medication/month (24.8%), and 4 medications/month (5.5%). Five trajectory groups were identified for CP + NDDs: 0 (22.4%), 1 (25.6%), 2 (25.2%), 4 (18.4%), and 6 (8.4%) prescribed medications/month. For the secondary GBTM, 3 trajectory groups were identified for CP only: 80.5% were characterized as negligible probability of polypharmacy exposure, 10.8% as low probability, and 8.7% as high probability. Five trajectory groups were identified for CP + NDDs: 37.9% as negligible probability of polypharmacy exposure, 32.8% as constantly high probability, and 29.2% as changing probability (eg, increasing/decreasing). CONCLUSIONS: Children with CP are chronically exposed to differing levels of polypharmacy. Findings can help establish polypharmacy surveillance practices. Studies need to determine if polypharmaceutical strategies are balanced to optimize health and development for children with CP. DISCLOSURES: Dr Whitney is supported by the University of Michigan Office of Health Equity and Inclusion Diversity Fund. The funding source had no role in the design or conduct of the study; collection, management, analysis, or interpretation of the data; preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

PMID: 36580123

46. Persistent Inflammation in Cerebral Palsy: Pathogenic Mediator or Comorbidity? A Scoping Review
Madison C B Paton, Megan Finch-Edmondson, Russell C Dale, Michael C Fahey, Claudia A Nold-Petry, Marcel F Nold, Alexandra R Griffin, Iona Novak

Review J Clin Med. 2022 Dec 12;11(24):7368. doi: 10.3390/jcm11247368.

Research has established inflammation in the pathogenesis of brain injury and the risk of developing cerebral palsy (CP). However, it is unclear if inflammation is solely pathogenic and primarily contributes to the acute phase of injury, or if inflammation persists with consequence in CP and may therefore be considered a comorbidity. We conducted a scoping review to identify studies that analyzed inflammatory biomarkers in CP and discuss the role of inflammation in the pathogenesis of CP and/or as a comorbidity. Twelve included studies reported a range of analytes, methods and biomarkers, including indicators of inflammatory status, immune function and genetic changes. The majority of controlled studies concluded that one or more systemic biomarkers of inflammation were significantly different in CP versus controls; most commonly serum or plasma cytokines such as tumor necrosis factor, Interleukin (IL)-6 and IL-10. In addition, differences in inflammation were noted in distinct subgroups of CP (e.g., those with varying severity). The available evidence supports the pathogenic role of inflammation and its ongoing role as a comorbidity of CP. This review shows that inflammation may persist for decades, driving functional impairment across development and into adulthood. However, inflammation is complex, thus further research will increase our understanding.

PMID: 36555983

47. Co-designing resources to support the transition from child to adult health services for young people with cerebral palsy: A design thinking approach
Jennifer Fortune, Jessica Burke, Conor Dillon, Sally Dillon, Sharon O'Toole, Ann Enright, Annmarie Flynn, Manjula Manikandan, Thilo Kroll, Grace Lavelle, Jennifer M Ryan

Front Rehabil Sci. 2022 Dec 16;3:976580. doi: 10.3389/fresc.2022.976580. eCollection 2022.

Introduction: Design thinking is a human-centred process that aims to identify the needs of end-users and iteratively develop solutions. Involving end-users in the development and design of solutions may enhance effectiveness by increasing focus on the needs of the target population. This paper describes the process of co-designing resources to support the transition from child-centred to adult-orientated health services using a design thinking approach. Methods: Five co-design workshops were conducted remotely with a young person advisory group and parent advisory group. A design thinking process guided by the Stanford D. School approach was used to understand the transition needs of young people and their parents and iteratively develop solutions to improve end-user experience. Results: Eight resource prototypes were generated: (1) designated transition coordinator, (2) digital stories of transition experience (3) written informational support (4) transition website, (5) transition checklists and worksheets (6) transition app, (7) transition programme or course and (8) educational programme for health professionals. Conclusion: Design thinking is a feasible approach to identify, characterise and prioritise resources collaboratively with end-user partners.

PMID: 36589713

48. "Thinking about myself?" Experiences of parents of adolescents with cerebral palsy: A qualitative study to guide the implementation of a service for families
Ana Paula M Silvério, Marisa C Mancini, Fernanda I T Antunes, Priscilla R P Figueiredo, Kátia M P Bueno, Marina B Brandão

Child Care Health Dev. 2023 Jan 3. doi: 10.1111/cch.13094. Online ahead of print.

Background: Recently, there has been an increase in the development of transition services for adolescents with cerebral palsy (CP). These studies have emphasized the importance of addressing parents' needs during their children's adolescence. Aims: To understand how parents experience adolescence and transition to adulthood of their adolescents with CP and to identify relevant components for the development of a service for families. Methods and procedures: A qualitative study was conducted with 18 families of adolescents with CP. Caregivers were purposely recruited from the Adolescence in Focus Program, a

transition program. Individual interviews were conducted using a semistructured script. Then, the caregivers were invited to participate in focus groups. The interviews and focus groups were recorded and transcribed for content analysis. Results: Three categories emerged: "The onset of adolescence"; "What will our future be?"; and "Support and services: paths to follow". The adolescents' behavioral changes seemed to be intensified by their restricted social participation. The parents reported the desire for their adolescents to become independent in daily activities. Regarding their own future, they aimed to reestablish the occupational roles that were interrupted. Conclusion: Information from this study guided the design of a program for families regarding content, format and outcomes.

PMID: 36597412

49. The Chinese version of the Caregiver Difficulties Scale: Psychometric evaluation
Xiaoying Zhong, Xiujing Guo, Li Zhang, Xiaorong Yang, Chen Jingyao, Dehua Li, Xiaoyong Chen, Hui Zhou, Champa J Wijesinghe

Child Care Health Dev. 2022 Dec 29. doi: 10.1111/cch.13093. Online ahead of print.

Background: Evaluating caregiver burden and its health impact is an essential component of long-term care plan for children with disabilities; the Caregiver Difficulties Scale (CDS) has high conceptual sensitivity. The aim of this study was to adapt the CDS to Chinese and investigates the psychometric properties of this tool. Methods: The study was carried out among caregivers of children with cerebral palsy (n = 194). The CDS, Caregivers Burden Inventory (CBI) and World Health Organization Quality of Life-BREF (WHOQOL-BREF) were used for data collection. Twenty experts were consulted to evaluate the content validity of the scale. The confirmatory factor analysis was conducted to measure the construct validity of CDS. The Spearman correlation coefficients were calculated among CDS, CBI and WHOQOL-BREF to examine the convergent validity and discriminant validity. The reliability was evaluated by examining internal consistency and test-retest reliability. Results: The result of expert consultation showed that the S-CVI was 0.894 and the I-CVI ranged from 0.70 to 1.00. The fit indices showed that the original correlated four-factor model of CDS was adequate: $\chi 2 = 268.397$; df = 243; $\chi 2$ /df = 1.105; RMSEA = 0.023; CFI = 0.985; NNFI = 0.869; TLI = 0.982; IFI = 0.986. The score of CDS was positively strong associated with the scores of CBI (r = +0.764); negatively correlating with the scores of WHOQOL-BREF (r = -0.627). The Cronbach's alpha was 0.840; intraclass correlation coefficient (ICC) value was 0.843. Conclusions: The Chinese version of the CDS is a valid and reliable tool to evaluate burden for caregivers of children with CP in China.

PMID: 36579786

50. Neonatal kaempferol exposure attenuates impact of cerebral palsy model on neuromotor development, cell proliferation, microglia activation, and antioxidant enzyme expression in the hippocampus of rats
Diego Bulcão Visco, Raul Manhães-de-Castro, Márcia Maria da Silva, Bárbara J R Costa-de-Santana, Joaci Pereira Dos Santos Junior, Luís Miguel Saavedra, Maria Daniele Teixeira Beltrão de Lemos, Juan José Valdéz-Alarcón, Claudia Jacques Lagranha, Omar Guzman-Quevedo, Luz Torner, Ana Elisa Toscano

Nutr Neurosci. 2022 Dec 28;1-22. doi: 10.1080/1028415X.2022.2156034. Online ahead of print.

Objectives: This study aims to assess the effect of neonatal treatment with kaempferol on neuromotor development, proliferation of neural precursor cells, the microglia profile, and antioxidant enzyme gene expression in the hippocampus. Methods: A rat model of cerebral palsy was established using perinatal anoxia and sensorimotor restriction of hindlimbs during infancy. Kaempferol (1 mg/ kg) was intraperitoneally administered during the neonatal period. Results: Neonatal treatment with kaempferol reduces the impact of the cerebral palsy model on reflex ontogeny and on the maturation of physical features. Impairment of locomotor activity development and motor coordination was found to be attenuated by kaempferol treatment during the neonatal period in rats exposed to cerebral palsy. Neonatal treatment of kaempferol in cerebral palsy rats prevents a substantial reduction in the number of neural precursor cells in the dentate gyrus of the hippocampus, an activated microglia profile, and increased proliferation of microglia in the sub-granular zone and in the granular cell layer. Neonatal treatment with kaempferol increases gene expression of superoxide dismutase and catalase in the hippocampus of rats submitted to the cerebral palsy model. Discussion: Kaempferol attenuates the impact of cerebral palsy on neuromotor behavior development, preventing altered hippocampal microglia activation and mitigating impaired cell proliferation in a neurogenic niche in these rats. Neonatal treatment with kaempferol also increases antioxidant defense gene expression in the hippocampus of rats submitted to the cerebral palsy model.

PMID: 36576161

Prevention and Cure

51. Effects of MgSO4 Alone or Associated with 4-PBA on Behavior and White Matter Integrity in a Mouse Model of Cerebral Palsy: A Sex- and Time-Dependent Study
Lou Legouez, Bérénice Le Dieu-Lugon, Shérine Feillet, Gaëtan Riou, Melissa Yeddou, Thibault Plouchart, Nathalie Dourmap, Marie-Anne Le Ray, Stéphane Marret, Bruno J Gonzalez, Carine Cleren

Int J Mol Sci. 2022 Dec 15;23(24):15947. doi: 10.3390/ijms232415947.

Cerebral palsy (CP) is defined as permanent disorders of movement and posture. Prematurity and hypoxia-ischemia (HI) are risk factors of CP, and boys display a greater vulnerability to develop CP. Magnesium sulfate (MgSO4) is administered to mothers at risk of preterm delivery as a neuroprotective agent. However, its effectiveness is only partial at long term. To prolong MgSO4 effects, it was combined with 4-phenylbutyrate (4-PBA). A mouse model of neonatal HI, generating lesions similar to those reported in preterms, was realized. At short term, at the behavioral and cellular levels, and in both sexes, the MgSO4/4-PBA association did not alter the total prevention induced by MgSO4 alone. At long term, the association extended the MgSO4 preventive effects on HI-induced motor and cognitive deficits. This might be sustained by the promotion of oligodendrocyte precursor differentiation after HI at short term, which led to improvement of white matter integrity at long term. Interestingly, at long term, at a behavioral level, sex-dependent responses to HI were observed. This might partly be explained by early sex-dependent pathological processes that occur after HI. Indeed, at short term, apoptosis through mitochondrial pathways seemed to be activated in females but not in males, and only the MgSO4/4-PBA association seemed to counter this apoptotic process.

PMID: 36555591

52. Sudden Unexpected Postnatal Collapse and Therapeutic Hypothermia: What's Going On?
Luca Bedetti, Licia Lugli, Elisabetta Garetti, Isotta Guidotti, Maria Federica Roversi, Elisa Della Casa, Francesca Miselli, Maria Carolina Bariola, Antonella Di Caprio, Marisa Pugliese, Fabrizio Ferrari, Alberto Berardi

Children (Basel). 2022 Dec 8;9(12):1925. doi: 10.3390/children9121925.

Sudden unexpected postnatal collapse (SUPC) is a rare event, potentially associated with catastrophic consequences. Since the beginning of the 2000s, therapeutic hypothermia (TH) has been proposed as a treatment for asphyxiated neonates after SUPC. However, only a few studies have reported the outcome of SUPC after TH. The current study presents the long-term neurodevelopmental outcome of four cases of SUPC treated with TH in a single Italian center. Furthermore, we reviewed the previous literature concerning 49 cases of SUPC treated with TH. Among 53 total cases (of whom four occurred in our center), 15 (28.3%) died before discharge from the NICU. A neurodevelopmental follow-up was available only for 21 (55.3%) out of the 38 surviving cases, and seven infants developed neurodevelopmental sequelae. TH should be considered in neonates with asphyxia after SUPC. However, SUPC is a rare event, and there is a lack of comparative clinical data to establish the risk/benefit of TH after SUPC with different degrees of asphyxia. Analysis of large cohorts of newborns with SUPC, whether treated with TH or untreated, are needed in order to better identify infants who should undergo TH.

PMID: 36553368

53. Efficacy and safety of stem cell therapy in cerebral palsy: A systematic review and meta-analysis
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Aim: Although the efficacy and safety of stem cell therapy for cerebral palsy has been demonstrated in previous studies, the number of studies is limited and the treatment protocols of these studies lack consistency. Therefore, we included all relevant studies to date to explore factors that might influence the effectiveness of treatment based on the determination of safety and efficacy. Methods: The data source includes PubMed/Medline, Web of Science, EMBASE, Cochrane Library, from inception to 2 January 2022. Literature was screened according to the PICOS principle, followed by literature quality evaluation to assess the risk of bias. Finally, the outcome indicators of each study were extracted for combined analysis. Results: 9 studies were included in the current analysis. The results of the pooled analysis showed that the improvements in both primary and secondary indicators except for Bayley Scales of Infant and Toddler Development were more skewed towards stem cell therapy than the control group. In the subgroup analysis, the results showed that stem cell therapy significantly increased Gross Motor Function Measure (GMFM) scores of 3, 6, and 12 months. Besides, improvements in GMFM scores were more skewed toward umbilical cord mesenchymal stem cells, low dose, and intrathecal injection. Importantly, there was no significant difference in the adverse events (RR = 1.13; 95% CI = [0.90, 1.42]) between the stem cell group and the control group. Conclusion: The results suggested that stem cell therapy for cerebral palsy was safe and effective. Although the subgroup analysis results presented guiding significance in the selection of clinical protocols for stem cell therapy, high-quality RCTs validations are still needed.

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54. Are We Getting It Right? A Scoping Review of Outcomes Reported in Cell Therapy Clinical Studies for Cerebral Palsy

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Cell therapies are an emergent treatment for cerebral palsy (CP) with promising evidence demonstrating efficacy for improving gross motor function. However, families value improvements in a range of domains following intervention and the non-motor symptoms, comorbidities and complications of CP can potentially be targeted by cell therapies. We conducted a scoping review to describe all outcomes that have been reported in cell therapy studies for CP to date, and to examine what instruments were used to capture these. Through a systematic search we identified 54 studies comprising 2066 participants that were treated with a range of cell therapy interventions. We categorized the reported 53 unique outcome instruments and additional descriptive measures into 10 categories and 12 sub-categories. Movement and Posture was the most frequently reported outcome category, followed by Safety, however Quality of Life, and various prevalent comorbidities and complications of CP were infrequently reported. Notably, many outcome instruments used do not have evaluative properties and thus are not suitable for measuring change following intervention. We provide a number of recommendations to ensure that future trials generate high-quality outcome data that is aligned with the priorities of the CP community.

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