

Monday 29 August 2022

Cerebral Palsy Alliance is delighted to bring you this free weekly bulletin of the latest published research into cerebral palsy. Our organisation is committed to supporting cerebral palsy research worldwide - through information, education, collaboration and funding. Find out more at cerebralpalsy.org.au/our-research

Professor Nadia Badawi AM
CP Alliance Chair of Cerebral Palsy Research

[Subscribe to CP Research News](#)

Interventions and Management

1. Hand function and self-care in children with cerebral palsy

No authors listed

Dev Med Child Neurol. 2022 Aug 24. doi: 10.1111/dmcn.15393. Online ahead of print.

No abstract available

PMID: [36002991](#)

2. Goals of children with unilateral cerebral palsy in a brain stimulation arm rehabilitation trial

No authors listed

Dev Med Child Neurol. 2022 Aug 24. doi: 10.1111/dmcn.15397. Online ahead of print.

No abstract available

PMID: [36002932](#)

3. Does hand function continue to develop in older children and adolescents with cerebral palsy?

Aviva L Wolff

Dev Med Child Neurol. 2022 Aug 20. doi: 10.1111/dmcn.15382. Online ahead of print.

No abstract available.

PMID: [35986667](#)

4. Hand Ownership Is Altered in Teenagers with Unilateral Cerebral Palsy

Corinna N Gerber, Didier L Gasser, Christopher John Newman

J Clin Med. 2022 Aug 19;11(16):4869. doi: 10.3390/jcm11164869.

We explored hand ownership in teenagers with unilateral cerebral palsy (UCP) compared with typically developing teenagers. Eighteen participants with UCP and 16 control teenagers participated. We used the rubber hand illusion to test hand ownership (HO). Both affected/non-affected hands (UCP) and dominant/non-dominant hands (controls) were tested during synchronous and asynchronous strokes. HO was assessed by measuring the proprioceptive drift toward the fake hand (as a percentage of arm length) and conducting a questionnaire on subjective HO. Both groups had significantly higher proprioceptive drift in the synchronous stroking condition for both hands. Teenagers with UCP showed a significantly higher proprioceptive drift when comparing their paretic hand (median 3.4% arm length) with the non-dominant hand of the controls (median 1.7% arm length). The questionnaires showed that synchronous versus asynchronous stroking generated a robust change in subjective HO in the control teenagers, but not in the teenagers with UCP. Teenagers with UCP have an altered sense of HO and a distorted subjective experience of HO that may arise from the early dysfunction of complex sensory-motor integration related to their brain lesions. HO may influence motor impairment and prove to be a target for early intervention.

PMID: [36013105](#)

5. Reduced wrist flexor H-reflex excitability is linked with increased wrist proprioceptive error in adults with cerebral palsy

S Shekar Dukkupati, Sarah J Walker, Michael P Trevarrow, Morgan Busboom, Sarah E Baker, Max J Kurz

Front Neurol. 2022 Aug 9;13:930303. doi: 10.3389/fneur.2022.930303. eCollection 2022.

Although most neurophysiological studies of persons with cerebral palsy (CP) have been focused on supraspinal networks, recent evidence points toward the spinal cord as a central contributor to their motor impairments. However, it is unclear if alterations in the spinal pathways are also linked to deficits in the sensory processing observed clinically. This investigation aimed to begin to address this knowledge gap by evaluating the flexor carpi radialis (FCR) H-reflex in adults with CP and neurotypical (NT) controls while at rest and during an isometric wrist flexion task. The maximal H-wave (Hmax) and M-wave (Mmax) at rest were calculated and utilized to compute Hmax/Mmax ratios (H:M ratios). Secondly, the facilitation of the H-wave was measured while producing an isometric, voluntary wrist flexion contraction (i.e., active condition). Finally, a wrist position sense test was used to quantify the level of joint position sense. These results revealed that the adults with CP had a lower H:M ratio compared with the NT controls while at rest. The adults with CP were also unable to facilitate their H-reflexes with voluntary contraction and had greater position sense errors compared with the controls. Further, these results showed that the adults with CP that had greater wrist position sense errors tended to have a lower H:M ratio at rest. Overall, these findings highlight that aberration in the spinal cord pathways of adults with CP might play a role in the sensory processing deficiencies observed in adults with CP.

PMID: [36016542](#)

6. Limb Length Discrepancy and Corticospinal Tract Disruption in Hemiplegic Cerebral Palsy

Hyo Sung Kim, Su Min Son

Children (Basel). 2022 Aug 10;9(8):1198. doi: 10.3390/children9081198.

This study aimed to investigate the relationship between the corticospinal tract (CST) and limb length discrepancy (LLD) in patients with hemiplegic cerebral palsy (CP). Using diffusion tensor tractography, a retrospective study on 92 pediatric patients with hemiplegic CP who visited our hospital from May 2017 to the end of 2020 was conducted. Limb length was measured by anthropometry to calculate LLD. The functional level of hemiplegia scale (Fxl), modified Ashworth scale, and manual muscle test (MMT) were evaluated for clinical function. Patients were classified into two groups according to the presence or absence of disruption of the affected CST: disruption (A) and preservation (B) groups. Fractional anisotropy (FA) and mean diffusivity (MD) of the affected CSTs were measured and correlated with LLD. The results of the independent t-test and chi-square test did not show significant differences between the two groups, except in the Fxl and finger extensor of MMT ($p < 0.05$). For

the LLD, there were no significant differences in total upper, total lower, and foot limb lengths. A significant difference was observed only in hand LLD ($p < 0.05$) from ANCOVA. Hand LLD was significantly correlated with FA ($r = -0.578$), MD ($r = 0.512$), and degree of CST disruption ($r = -0.946$) from the Pearson correlation test. The results of this study suggested that patients with hemiplegic CP would likely have LLD especially in the hand, and that CST evaluation using diffusion tensor tractography might be helpful in assessing and predicting LLD in hemiplegic CP.

PMID: [36010088](#)

7. Musculoskeletal Morbidity Among Adults Living With Spina Bifida and Cerebral Palsy

Heidi J Haapala, Mary Schmidt, Paul Lin, Neil Kamdar, Elham Mahmoudi, Mark D Peterson

Top Spinal Cord Inj Rehabil. 2022 Summer;28(3):73-84. doi: 10.46292/sci21-00078. Epub 2022 Aug 17.

Background: Individuals living with cerebral palsy (CP) or spina bifida (SB) are at heightened risk for chronic health conditions that may develop or be influenced by the impairment and/or the process of aging. **Objectives:** The objective of this study was to compare the incidence of and adjusted hazards for musculoskeletal (MSK) morbidities among adults living with and without CP or SB. **Methods:** A retrospective, longitudinal cohort study was conducted among adults living with ($n = 15,302$) CP or SB and without ($n = 1,935,480$) CP or SB. Incidence estimates of common MSK morbidities were compared at 4 years of enrollment. Survival models were used to quantify unadjusted and adjusted hazard ratios for incident MSK morbidities. The analyses were performed in 2019 to 2020. **Results:** Adults living with CP or SB had a higher 4-year incidence of any MSK morbidity (55.3% vs. 39.0%) as compared to adults without CP or SB, and differences were to a clinically meaningful extent. Fully adjusted survival models demonstrated that adults with CP or SB had a greater hazard for all MSK disorders; this ranged from hazard ratio (HR) 1.40 (95% CI, 1.33 to 1.48) for myalgia to HR 3.23 (95% CI, 3.09 to 3.38) for sarcopenia and weakness. **Conclusion:** Adults with CP or SB have a significantly higher incidence of and risk for common MSK morbidities as compared to adults without CP or SB. Efforts are needed to facilitate the development of improved clinical screening algorithms and early interventions to reduce risk of MSK disease onset/progression in these higher risk populations.

PMID: [36017121](#)

8. Periacetabular osteotomy with or without femoral osteotomy for the treatment of hip subluxation in children and young adults with cerebral palsy

Kangming Chen, Jinyan Wu, Chao Shen, Junfeng Zhu, Xiaodong Chen, Jun Xia

BMC Musculoskelet Disord. 2022 Aug 25;23(1):809. doi: 10.1186/s12891-022-05754-3.

Background: This study is aimed to investigate retrospectively the radiographic and clinical outcomes in children and young adults with cerebral palsy (CP) undergoing periacetabular osteotomy (PAO) with or without femoral osteotomy (FO) for hip subluxation. **Methods:** A consecutive cohort of twenty-one patients (23 hips) with symptomatic CP hip subluxation were treated with PAO with or without FO and reviewed retrospectively. Two patients (2 hips) were excluded due to insufficient follow-up and lost to follow-up, respectively. The Reimers migration percentage, lateral center-edge angle (LCEA), Sharp angle, neck-shaft angle (NSA), femoral anteversion (FNA), Gross Motor Function Classification System (GMFCS) and hip pain were assessed. **Results:** Twenty-one hips (19 patients) with CP treated with PAO with or without FO were included. Five hips received PAO. Sixteen hips underwent PAO with FO. Mean age at surgery was 19 ± 6 and 15 ± 4 years for PAO and PAO plus FO, respectively. Mean follow-up was 44.0 ± 28.3 months for PAO and 41.5 ± 17.2 months for PAO + FO. All hips were painful before surgery and painless at final visits. The GMFCS improved by one level in 10 of 19 patients. There was significant increase in LCEA ($p < 0.001$) and decrease in the Reimer's MP ($p < 0.001$), NSA ($p < 0.001$) and Tonnis angle ($p < 0.001$) postoperatively. Resubluxation occurred in 7 hips (30%) due to insufficient correction and loosening of fixation. Nervus cutaneus femoris lateralis was impaired in 4 patients after surgery. There was no avascular necrosis of the femoral head, resubluxation or infection. **Conclusion:** PAO with or without FO can be effective for children and young adults with concomitant hip subluxation and CP.

PMID: [36002815](#)

9. Influence of sagittal pelvic attitude on gait pattern in normally developed people and interactions with neurological pathologies: A pilot study

Martina Favetta, Alberto Romano, Susanna Summa, Alessandra Colazza, Silvia Minosse, Gessica Vasco, Enrico Castelli, Maurizio Petrarca

Front Hum Neurosci. 2022 Aug 4;16:797282. doi: 10.3389/fnhum.2022.797282. eCollection 2022.

Background: Gait Analysis of healthy people, imitating pathological conditions while walking, has increased our understanding of biomechanical factors. The influence of the pelvis as a biomechanical constraint during gait is not specifically studied. How could mimicking a pelvic attitude influence the dynamic mechanical interaction of the body segments? We proposed an investigation of the pelvic attitude role on the gait pattern of typically developed people when they mimicked pelvic anteversion and posteroversion. **Materials and methods:** Seventeen healthy volunteers were enrolled in this study (mean age 24.4 ± 5.5). They simulated a pelvic anteversion and posteroversion during walking, exaggerating these postures as much as possible. 3D gait analysis was conducted using an optoelectronic system with eight cameras (Vicon MX, Oxford, United Kingdom) and two force plates (AMTI, Or-6, Watertown, MA, United States). The kinematic, kinetic, and spatio-temporal parameters were compared between the three walking conditions (anteversion, posteroversion, and normal gait). **Results:** In Pelvic Anteversion gait (PA) we found: increased hip flexion ($p < 0.0001$), increased knee flexion during stance ($p = 0.02$), and reduction of ankle flexion-extension Range of Motion (RoM) compared with Pelvic Normal gait (PN). In Pelvic Posteroversion gait (PP) compared with PN, we found: decreased hip flexion-extension RoM ($p < 0.01$) with a tendency to hip extension, decreased knee maximum extension in stance ($p = 0.033$), and increased ankle maximum dorsiflexion in stance ($p = 0.002$). **Conclusion:** The configuration of PA contains gait similarities and differences when compared with pathologic gait where there is an anteversion as seen in children with Cerebral Palsy (CP) or Duchenne Muscular Dystrophy (DMD). Similarly, attitudes of PP have been described in patients with Charcot-Marie-Tooth Syndrome (CMT) or patients who have undergone Pelvic Osteotomy (PO). Understanding the dynamic biomechanical constraints is essential to the assessment of pathological behavior. The central nervous system adapts motor behavior in interaction with body constraints and available resources.

PMID: [35992946](#)

10. Are atypical knee jerk responses prognostic for cerebral palsy in high-risk infants and children?

Antigone S Papavasiliou

Editorial Eur J Paediatr Neurol. 2022 Aug 18;S1090-3798(22)00122-2. doi: 10.1016/j.ejpn.2022.08.004. Online ahead of print.

No abstract available

PMID: [35995708](#)

11. Lower-limb joint-coordination and coordination variability during gait in children with cerebral palsy

C Dussault-Picard, P Ippersiel, H Böhm, C P Dixon

Clin Biomech (Bristol, Avon). 2022 Aug 14;98:105740. doi: 10.1016/j.clinbiomech.2022.105740. Online ahead of print.

Background: Children with cerebral palsy present with poor motor control, altering their ability to perform tasks such as walking. Continuous relative phase analysis is a popular method to quantify motor control impairments via inter-joint coordination and coordination variability; however, it has not been explored in children with cerebral palsy. **Methods:** 45 children with cerebral palsy and 45 typically developing children walked while fit with retroreflective markers. Continuous relative phase analysis for knee-hip and ankle-knee joint pairs quantified inter-joint coordination and coordination variability. The Gait Profile Score estimated gait pathology. Group differences were assessed with unpaired t-tests for coordination amplitude and variability (knee-hip, ankle-knee) across gait events. For the cerebral palsy group, correlations assessed the relation between the gait profile score and coordination metrics. **Findings:** The cerebral palsy group showed more in-phase patterns for knee-hip coupling compared to the typically developing group (initial contact, loading response, mid-stance, terminal swing) ($p \leq 0.03$). The cerebral palsy group showed lower knee-hip coordination variability (mid-stance, mid-swing) ($p \leq 0.037$) and lower ankle-knee coordination variability (initial contact, loading response, terminal swing) ($p < 0.001$). The gait profile score correlated weakly to moderately ($r = [0.323-0.472]$), and negatively with the knee-hip inter-joint coordination

(initial contact, loading response, mid-stance, terminal swing) ($p \leq 0.042$). Interpretation: Children with cerebral palsy showed a more in-phase gait strategy during challenging transitional gait cycle phases (beginning and end) and less flexible and adaptable motor behaviors. Moreover, the correlation between in-phase joint patterns and increased gait deviations (gait profile score) reinforces the relevance of coordination analysis to assess motor control impairment.

PMID: [35987170](#)

12. Influence of the number of muscles and strides on selective motor control during gait in individuals with cerebral palsy

Gilad Sorek, Marije Goudriaan, Itai Schurr, Simon-Henri Schless

J Electromyogr Kinesiol. 2022 Aug 17;66:102697. doi: 10.1016/j.jelekin.2022.102697. Online ahead of print.

Objective: To evaluate the influence of the number of muscles and strides on estimating motor control accuracy during treadmill-gait, in individuals with cerebral palsy (CP). **Methods:** Bilateral lower limb electromyography data were extracted for 44 children/adolescents with CP. The number of synergy solutions required to explain 90 % of the variance (tVAF-threshold) and the total variance accounted for by one synergy (tVAF1) were calculated for a different number of strides (between 5 and 50) and muscles both unilaterally (four to seven) and bilaterally (eight to 14). The kappa and intraclass correlation coefficients were used to assess similarities in tVAF-threshold and tVAF1 between the different number of strides and muscle sets. **Results:** In both analyses, the number of muscles influenced the tVAF-threshold. Additionally, using <30 strides led to only substantial-moderate agreement with 50 strides ($k < 0.80$). In both analyses, the mean tVAF1 values demonstrated high-agreement between the different number of muscles (intraclass-correlations = 0.88-0.93) and strides (intraclass-correlations = 0.96-0.99); In the group level, it may result in an error of ≤ 2.3 %. However, in the individual level, using different number of muscles or <40 strides may result in an error of ≥ 6 %. **Conclusion:** Differing numbers of muscles and strides did not influence the group mean tVAF1 value, but it influenced the tVAF-threshold value. In addition, using different number of muscles or strides can lead to a large measurement error in the individual tVAF1 value.

PMID: [36027660](#)

13. Transversal Malalignment and Proximal Involvement Play a Relevant Role in Unilateral Cerebral Palsy Regardless the Subtype

Stefanos Tsitlakidis, Sarah Campos, Nicholas A Beckmann, Sebastian I Wolf, Sébastien Hagmann, Tobias Renkawitz, Marco Götz

J Clin Med. 2022 Aug 17;11(16):4816. doi: 10.3390/jcm11164816.

Classification of gait disorders in cerebral palsy (CP) remains challenging. The Winters, Gage, and Hicks (WGH) is a commonly used classification system for unilateral CP regarding the gait patterns (lower limb kinematics) solely in the sagittal plane. Due to the high number of unclassified patients, this classification system might fail to depict all gait disorders accurately. As the information on trunk/pelvic movements, frontal and transverse planes, and kinetics are disregarded in WGH, 3D instrumented gait analysis (IGA) for further characterization is necessary. The objective of this study was a detailed analysis of patients with unilateral CP using IGA taking all planes/degrees of freedom into account including pelvic and trunk movements. A total of 89 individuals with unilateral CP matched the inclusion criteria and were classified by WGH. Subtype-specific differences were analyzed. The most remarkable findings, in addition to the established WGH subtype-specific deviations, were pelvic obliquity and pelvic retraction in all WGH types. Furthermore, the unclassified individuals showed altered hip rotation moments and pelvic retraction almost throughout the whole gait cycle. Transversal malalignment and proximal involvement are relevant in all individuals with unilateral CP. Further studies should focus on WGH type-specific rotational malalignment assessment (static vs. dynamic, femoral vs. tibial) including therapeutic effects and potential subtype-specific compensation mechanisms and/or tertiary deviations of the sound limb.

PMID: [36013051](#)

14. Long-term outcome of extraarticular subtalar arthrodesis in children with cerebral palsy using modified Grice technique

Jiri Jochymek, Tereza Peterkova

Acta Orthop Belg. 2022 Jun;88(2):223-230. doi: 10.52628/88.2.9026.

The purpose of the study is to describe and analyse long-term results of the modified Grice procedure with specially prepared pre-shaped autograft from iliac crest. 54 patients (101 feet) who underwent modified Grice procedure, were retrospectively analysed. Before and after the surgery, talocalcaneal (TC) angle and calcaneal inclination (CI) angle were measured and compared with post-operative values. Furthermore, AOFAS score was assessed pre- and postoperatively as well as the subjective evaluation of the patients or their parents. Detailed analysis was performed separately for patients with different forms of CP. Postoperatively, TC angle and subjective assessment decreased, and CI angle and AOFAS score increased significantly compared to pre-operative values. The significant difference was observed among different CP groups in all observed parameters. Severe complications were not observed. The modified Grice procedure with specially prepared pre-shaped autograft showed promising long-term results.

PMID: [36001826](#)

15. Determining Incidence and Risk Factors of Pressure Injury after Orthopaedic Surgery in Children and Adolescents with Neuromuscular Complex Chronic Conditions

Aneesh V Samineni, Patricia E Miller, Christopher Hopkinson, Rachel DiFazio, Sandy Quigley, Colyn J Watkins, Benjamin J Shore

J Pediatr Orthop. 2022 Aug 23. doi: 10.1097/BPO.0000000000002242. Online ahead of print.

Background: Pressure injuries are serious yet often preventable alterations in skin integrity prevalent in orthopaedics, especially in pediatric patients with neuromuscular complex chronic conditions (NCCC). The aims of this study were to (1) estimate incidence of pressure injury in children with NCCC after orthopaedic surgery; (2) determine risk factors for pressure injury development; and (3) describe severity and location of pressure injuries. **Methods:** Children and adolescents (<22 y old) with NCCC who underwent orthopaedic surgery at a single tertiary-care children's hospital between 2016 and 2020 were retrospectively identified. A matched case-control design was used to match patients who developed a pressure injury within 1.5 months after surgery to subjects who did not develop a pressure injury using a 1:1 matching based on neuromuscular diagnosis, age, sex, and type of surgery. Patient characteristics, comorbidities, pressure injury characteristics, and a pressure injury risk assessment score utilizing the Braden QD scale were compared across pressure injury groups. **Results:** Of 564 children with NCCC who underwent orthopaedic surgery, 43 (7.6%) developed a postoperative pressure injury. Pressure injuries were primarily located on the heel, followed by sacral/groin/buttocks, then knee. The most common diagnosis was cerebral palsy with associated neuromuscular scoliosis, and hip reconstruction was the most common surgical procedure. The pressure injury cohort had significantly more patients who were non-ambulatory (GMFCS IV/V), with a seizure disorder, g-tube, nonverbal status, wheelchair usage, and had additional medical devices. Median Braden QD risk score was higher in the injury cohort and a cutoff ≥ 12 was optimal for predicting pressure injury development. **Conclusions:** Pressure injuries after orthopaedic surgery are not uncommon in children with NCCC. The entire care team should be aware of additional risk factors associated with pressure injury development, including the diagnosis of cerebral palsy with neuromuscular scoliosis, seizure disorder, nonverbal status, g-tube, and the presence of multiple medical devices. Implementation of evidence-based pressure injury prevention guidelines on identified high-risk children with NCCC may reduce pressure injury risk and improve the postoperative course. Level of evidence: Level III.

PMID: [35993598](#)

16. Pilates-based exercises for gait and balance in ambulant children with cerebral palsy: feasibility and clinical outcomes of a randomised controlled trial

Clodagh Coman, Dara Meldrum, Damien Kiernan, Ailish Malone

Disabil Rehabil. 2022 Aug 23;1-12. doi: 10.1080/09638288.2022.2110617. Online ahead of print.

Purpose: To determine if Pilates-based exercise classes could be feasible and effective in changing gait kinematics and balance in ambulant children with Cerebral Palsy (CP). **Materials and methods:** A single-blind multi-centre randomised controlled trial compared a four-week, twice-weekly Pilates-based exercise class to a usual exercise control, for ambulant children with CP. **Clinical outcome measures** were three-dimensional trunk and lower limb kinematics during walking on level ground, uneven ground and crossing an obstacle; and clinical balance measures. **Feasibility outcomes** were adherence and enjoyment. **Results:** Forty-six children (29 male, mean age 10 years 8 months (range 7-17 years), 23 per group) participated. After the four-week intervention, there were no significant between-group differences in trunk or lower limb gait kinematics. Differences were detected in Berg Balance Scale (1.38 points, 95% CI 0.58-2.18) and Functional Walking Test (1.40 points, 95% CI 0.58-2.22), but they were less than the minimum clinically important difference and therefore clinically insignificant. Median class attendance was 5/8 classes. **Conclusion:** Pilates-based exercises did not change lower limb or trunk kinematics during walking in children with CP and had a clinically insignificant impact on balance. Lower than anticipated adherence prompts consideration of more flexible delivery of future interventions. **Implications for Rehabilitation:** Ambulant children with CP can experience impairment of trunk control, negatively impacting balance and gait. In this study, Pilates-based exercise classes did not change kinematics of the trunk or lower limbs during walking and led to negligible improvement in functional balance. Children did not manage to do their Home Exercise Programme, indicating that Pilates-based exercise should be delivered within supervised practice. Children missed on average one in three classes due to unforeseen circumstances, so this should be anticipated when planning group classes.

PMID: [35996891](#)

17. The Effectiveness of Sensory Integration Interventions on Motor and Sensory Functions in Infants with Cortical Vision Impairment and Cerebral Palsy: A Single Blind Randomized Controlled Trial

Mustafa Cemali, Serkan Pekçetin, Esra Aki

Children (Basel). 2022 Jul 27;9(8):1123. doi: 10.3390/children9081123.

Cortical vision impairment (CVI) and Cerebral Palsy (CP) lead to decrement in sensory and motor functions of infants. The current study examined the effectiveness of sensory integration interventions on sensory, motor, and oculomotor skills in infants with cortical vision impairment. Thirty-four infants with and CP aged 12-18 months were enrolled to the study. The infants were randomly divided into two groups as the control and intervention groups. The intervention group took sensory integration intervention 2 days a week for 8 weeks in addition to conventional physiotherapy 2 days a week for 8 weeks. The control group only received the conventional physiotherapy program 2 days a week for 8 weeks. The duration of the treatment sessions were 45 min for both interventions. Before and after the intervention, sensory processing functions were evaluated with the Test of Sensory Functions in Infants (TSFI), and motor functions were evaluated with the Alberta Infant Motor Scale (AIMS). There was a statistically significant difference between the pre- and post-test mean TSFI total and AIMS scores in the intervention group and control group ($p < 0.001$). The intervention group mean TSFI scores were more statistically significant than the those of the control group. Mean post-intervention AIMS scores did not differ between groups. Sensory integration intervention delivered with the conventional physiotherapy program was more effective than the conventional physiotherapy program in increasing sensory processing skills in one measure in infants with CVI and CP.

PMID: [36010014](#)

18. Associations Between Maternal Antenatal Corticosteroid Treatment and Psychological Developmental and Neurosensory Disorders in Children

Katri Räikkönen, Mika Gissler, Terhi Tapiainen, Eero Kajantie

JAMA Netw Open. 2022 Aug 1;5(8):e2228518. doi: 10.1001/jamanetworkopen.2022.28518.

Importance: Corticosteroids administered to women at risk of imminent preterm birth is one of the most effective ways to improve the prognosis of infants born preterm. Scant data about long-term neurodevelopmental and neurosensory outcomes among the treatment-exposed children are mixed, suggesting that not all domains of neurodevelopmental and neurosensory function may be equally affected. Moreover, the long-term outcomes may vary according to whether the treatment-exposed children are being born preterm (<37 weeks and 0 days) or term (≥ 37 weeks and 0 days). **Objectives:** To study whether antenatal corticosteroid treatment is associated with psychological developmental and neurosensory disorders in children born term and preterm and whether the associations persist in a sibling-comparison design. **Design, setting, and participants:** This population-based retrospective register-linkage study comprised all singleton live births in Finland between January 1, 2006,

and December 31, 2017, followed up until December 31, 2018, as well as a sibling comparison among term sibling pairs. Data were analyzed from March 21, 2021, to July 7, 2022. Exposures: Antenatal corticosteroid treatment. Main outcomes and measures: Cox proportional hazards regression models were used to estimate the associations between antenatal corticosteroid treatment and physician-diagnosed specific developmental disorders of speech and language, scholastic skills, and motor function; pervasive developmental disorder; other or unspecified psychological developmental disorder; disorders of vision and hearing; epilepsy; and cerebral palsy. Results: The study population comprised 670 097 singleton children (342 562 boys [51.1%]) followed up for a median of 5.8 years (IQR, 3.1-8.7 years). Of the 14 868 treatment-exposed children (2.2%; 53.9% boys), 6730 (45.3%) were born term, and 8138 (54.7%) were born preterm, and of the 655 229 nonexposed children (97.8%; 51.1% boys), 634 757 (96.9%) were born term, and 20 472 (3.1%) were born preterm. Of the 241 621 eligible maternal sibling pairs born term, 4128 (1.7%) were discordant for treatment exposure. Compared with nonexposure in the entire population, treatment exposure was significantly associated with higher adjusted hazard ratios (aHRs) for specific developmental disorders of speech and language (aHR, 1.38 [95% CI, 1.27-1.50]; $P < .001$), specific developmental disorders of scholastic skills (aHR, 1.32 [95% CI, 1.13-1.54]; $P = .004$), specific developmental disorder of motor function (aHR, 1.32 [95% CI, 1.18-1.49]; $P < .001$), pervasive developmental disorder (aHR, 1.35 [95% CI, 1.17-1.56]; $P < .001$), other or unspecified disorder of psychological development (aHR, 1.88 [95% CI, 1.58-2.25]; $P < .001$), and vision or hearing loss (aHR, 1.22 [95% CI, 1.04-1.43]; $P = .02$). Compared with nonexposure in the term-born group, treatment exposure was significantly associated with higher aHRs for specific developmental disorders of speech and language (aHR, 1.47 [95% CI, 1.31-1.66]; $P < .001$), specific developmental disorders of scholastic skills (aHR, 1.28 [95% CI, 1.01-1.63]; $P = .04$), specific developmental disorder of motor function (aHR, 1.38 [95% CI, 1.12-1.70]; $P < .001$), pervasive developmental disorder (aHR, 1.42 [95% CI, 1.16-1.75]; $P < .001$), other or unspecified disorder of psychological development (aHR, 1.92 [95% CI, 1.51-2.43]; $P < .001$), epilepsy (aHR, 1.57 [95% CI, 1.22-2.01]; $P < .001$), and cerebral palsy (aHR, 2.18 [95% CI, 1.47-3.23]; $P < .001$). The hazard for any psychological developmental and neurosensory disorder was significantly higher for the treatment-exposed sibling compared with the nonexposed cosibling (absolute difference, 1.2% [95% CI, 0.03%-2.4%]; $P < .001$; aHR, 1.22 [95% CI, 1.04-1.42]; $P = .01$). Antenatal corticosteroids were not associated with either significant benefit or risk in the preterm group. Conclusions and relevance: This study suggests that the possible long-term psychological developmental and neurosensory harms warrant careful consideration of risks and benefits when deciding on maternal antenatal corticosteroid treatment.

PMID: [36001315](#)

19. Bronchopulmonary dysplasia and neurobehavioural outcomes at birth and 2 years in infants born before 30 weeks

Monika Martin, Lynne Smith, Julie A Hofheimer, Elisabeth C McGowan, T Michael O'Shea, Steve Pastyrnak, Brian Scott Carter, Jennifer Helderman, Jennifer Check, Charles Neal, Mary B Roberts, Lynne M Danserea, Sheri A Della Grotta, Barry M Lester

Arch Dis Child Fetal Neonatal Ed. 2022 Aug 23;fetalneonatal-2021-323405. doi: 10.1136/archdischild-2021-323405. Online ahead of print.

Objective: To identify neurobehavioural risks in preterm infants with bronchopulmonary dysplasia (BPD) prior to hospital discharge. Design and patients: Longitudinal study of 676 newborns born before 30 weeks of gestation. Setting: Nine university NICUs affiliated with six universities. All were Vermont Oxford Network (VON) participants. Patients and interventions: Infants were enrolled in the Neonatal Neurobehavior and Outcomes in Very Preterm Infants Study from April 2014 to June 2016. Prospective medical record reviews, VON definitions and criteria, and maternal interviews were used to collect maternal and neonatal medical variables and socioenvironmental data. Main outcome measures: NICU Network Neurobehavioral Scale (NNNS) at the time of hospital discharge; Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) and Gross Motor Function Classification System at 2 years' corrected age. Results: Infants with moderate/severe BPD were less attentive (Wald χ^2 9.68, $p=0.008$), more lethargic (Wald χ^2 9.91, $p=0.007$), with increased non-optimal reflexes (Wald χ^2 7.37, $p=0.025$). Infants with moderate/severe BPD were more likely to have Bayley-III language and motor scores <85 (adjusted OR (aOR) 1.74, 95% CI 1.06 to 2.85, and aOR 2.06, 95% CI 1.10 to 3.85). Infants with both moderate/severe and mild BPD were more likely to have a cerebral palsy diagnosis (aOR 2.96, 95% CI 1.34 to 6.54, and aOR 2.81, 95% CI 1.32 to 5.99). Conclusions: BPD severity presents risks for poor neurodevelopment at NICU discharge and at age 2 years. Early identification of poorly regulated behaviour can provide critical information for early preventive and targeted interventions with potential to improve long-term outcomes.

PMID: [35999044](#)

20. Unique Pain Responses in Different Etiological Subgroups of Intellectual and Developmental Disabilities

Ruth Defrin, Tali Benromano, Chaim G Pick

Am J Intellect Dev Disabil. 2022 Sep 1;127(5):417-430. doi: 10.1352/1944-7558-127.5.417.

We studied whether there exist variations in pain responses between different intellectual and developmental disability (IDD) etiologies. Self-reports and facial expressions (Facial Action Coding System = FACS) were recorded during experimental pressure stimuli and compared among 31 individuals with IDD-13 with cerebral palsy (CP), nine with Down syndrome (DS), nine with unspecified origin (UIDD)-and among 15 typically developing controls (TDCs). The CP and DS groups had higher pain ratings and FACS scores compared to the UIDD and TDC groups, and steeper stimulus-response functions. The DS group exhibited the most diverse facial expressions. There were variations in the foci of facial expressions between groups. It appears that different IDD etiologies display distinct pain responses.

PMID: [36018766](#)

21. Risk factors for hip displacement in cerebral palsy: A population-based study of 121 nonambulatory children

Terje Terjesen, Joachim Horn

J Child Orthop. 2022 Aug;16(4):306-312. doi: 10.1177/18632521221113424. Epub 2022 Aug 2.

Purpose: The aim was to evaluate which clinical and radiographic variables are independent (true) risk factors for hip subluxation in nonambulatory children below 5 years of age with cerebral palsy. **Methods:** Patients were recruited from a population-based hip surveillance program. Inclusion criteria were birth during 2002-2006, age below 5 years, and gross motor function classification system levels III-V. In all, 121 children (71 boys) met these criteria. Gross motor function classification system was level III in 29 patients, level IV in 28, and level V in 64. Anteroposterior radiographs at diagnosis and during follow-up were assessed, and only the worst hip of each patient was used for the analyses. The mean age at the initial radiograph was 2.5 years (range: 0.7-4.9 years), and the mean follow-up time was 4.0 years (range: 0.5-11.8 years). **Results:** At the last follow-up, 67 children had a clinically significant hip displacement, defined as migration percentage $\geq 40\%$. Univariable regression analysis defined these risk factors: gross motor function classification system level V, spastic bilateral cerebral palsy, initial migration percentage, yearly rate of migration percentage progression, and initial acetabular index. When these variables were analyzed with multivariable regression in 107 patients with initial migration percentage $< 50\%$ and follow-up ≥ 1.0 year, the independent risk factors were initial migration percentage ($p = 0.003$) and yearly rate of migration percentage progression ($p < 0.001$). **Conclusion:** The parameters that need to be assessed in hip surveillance in children below 5 years of age are initial migration percentage and rate of migration percentage progression. Acetabular index and femoral head-shaft angle might be useful later for decision-making regarding choice of treatment. Level of evidence: Level II, development of diagnostic criteria.

PMID: [35992522](#)

22. Utility of data linkage for orthopaedic service planning in the paediatric population with cerebral palsy at Starship Children's Hospital

Wendy He, Alexandra Sorhage, Nichola C Wilson, N Susan Stott

N Z Med J. 2022 Aug 5;135(1559):85-94.

Aims: To determine the accuracy of orthopaedic surgical procedure coding (ICD-10-AM/ACHI/ACS) for children with cerebral palsy (CP) at Starship Children's Hospital, use data linkage with the New Zealand Cerebral Palsy Register (NZCPR) to obtain demographic and clinical information for children with CP requiring orthopaedic surgical services in the Auckland District Health Board catchment area, and to determine if trends in the clinical and demographic data are useful for future service planning for children with CP. **Methods:** Surgical admission data for children with CP aged 0-18 years at the time of their first procedure were extracted from Auckland District Health Board records for 2013-2018, and information on demographics and Gross Motor Function Classification System level were obtained from the NZCPR. The ICD-10-AM/ACHI/ACS codes for surgery/intervention were matched with the operation notes in the electronic health records using NHI numbers and assessed for accuracy. **Results:** During the study period, 261 paediatric patients with CP underwent orthopaedic procedures, which could be grouped broadly into five categories (spine, upper limb, lower limb, Botulinum-A toxin injection only, and other) with a coding accuracy of 95%. Clinical and demographic data could be obtained from the NZCPR for 232 (88.9%) of the 261 patients. **Conclusions:** Using orthopaedic surgical procedure codes, we could identify broad categories of procedures received by children with CP and the demographic and clinical characteristics of these children, which will assist

with service planning and identify trends in care delivery.

PMID: [35999784](#)

23. Unmet Health Needs among Young Adults with Cerebral Palsy in Ireland: A Cross-Sectional Study

Jennifer M Ryan, Michael Walsh, Mary Owens, Michael Byrne, Thilo Kroll, Owen Hensey, Claire Kerr, Meriel Norris, Aisling Walsh, Grace Lavelle, Jennifer Fortune

J Clin Med. 2022 Aug 18;11(16):4847. doi: 10.3390/jcm11164847.

Data describing the unmet health needs of young adults with cerebral palsy (CP) may support the development of appropriate health services. This study aimed to describe unmet health needs among young adults with CP in Ireland and examine if these differed between young adults who were and were not yet discharged from children's services. In this cross-sectional study, young adults with CP aged 16-22 years completed a questionnaire assessing unmet health needs. Logistic regression was used to examine the association between discharge status and unmet health needs. Seventy-five young adults (mean age 18.4 yr; 41% female; 60% in GMFCS levels I-III) were included in the study. Forty (53%) had been discharged from children's services. Unmet health need, as a proportion of those with needs, was highest for speech (0.64), followed by epilepsy (0.50) and equipment, mobility, control of movement and bone or joint problems (0.39 or 0.38). After adjusting for ambulatory status, unmet health needs did not differ according to discharge status. The proportion of young adults with unmet health needs highlights the importance of taking a life-course approach to CP and providing appropriate services to people with CP regardless of age.

PMID: [36013083](#)

24. Health service use and experiences among adults with cerebral palsy: A mixed method systematic review

No authors listed

Dev Med Child Neurol. 2022 Aug 24. doi: 10.1111/dmcn.15396. Online ahead of print.

No abstract available

PMID: [36002938](#)

25. Bihemispheric developmental alterations in basal ganglia volumes following unilateral perinatal stroke

Jordan Hassett, Helen Carlson, Ali Babwani, Adam Kirton

Neuroimage Clin. 2022;35:103143. doi: 10.1016/j.nicl.2022.103143. Epub 2022 Aug 4.

Introduction: Perinatal stroke affects millions of children and results in lifelong disability. Two forms prevail: arterial ischemic stroke (AIS), and periventricular venous infarction (PVI). With such focal damage early in life, neural structures may reorganize during development to determine clinical function, particularly in the contralesional hemisphere. Such processes are increasingly understood in the motor system, however, the role of the basal ganglia, a group of subcortical nuclei that are critical to movement, behaviour, and learning, remain relatively unexplored. Perinatal strokes that directly damage the basal ganglia have been associated with worse motor outcomes, but how developmental plasticity affects bilateral basal ganglia structure is unknown. We hypothesized that children with perinatal stroke have alterations in bilateral basal ganglia volumes, the degree of which correlates with clinical motor function. **Methods:** Children with AIS or PVI, and controls, aged 6-19 years, were recruited from a population-based cohort. MRIs were acquired on a 3 T GE MR750w scanner. High-resolution T1-weighted images (166 slices, 1 mm isotropic voxels) underwent manual segmentations of bilateral caudate and putamen. Extracted volumes were corrected for total intracranial volume. A structure volume ratio quantified hemispheric asymmetry of caudate and putamen (non-dominant/dominant hemisphere structure volume) with ratios closer to 1 reflecting a greater degree of symmetry between structures. Participants were additionally dichotomized by volume ratios into two groups, those with

values above the group mean (0.8) and those below. Motor function was assessed using the Assisting Hand Assessment (AHA) and the Box and Blocks test in affected (BBTA) and unaffected (BBTU) hands. Group differences in volumes were explored using Kruskal-Wallis tests, and interhemispheric differences using Wilcoxon. Partial Spearman correlations explored associations between volumes and motor function (factoring out age, and whole-brain white matter volume, a proxy for lesion extent). Results: In the dominant (non-lesioned) hemisphere, volumes were larger in AIS compared to PVI for both the caudate ($p < 0.05$) and putamen ($p < 0.01$) but comparable between stroke groups and controls. Non-dominant (lesioned) hemisphere volumes were larger for controls than AIS for the putamen ($p < 0.05$), and for the caudate in PVI ($p = 0.001$). Interhemispheric differences showed greater dominant hemisphere volumes for the putamen in controls ($p < 0.01$), for both the caudate ($p < 0.01$) and putamen ($p < 0.001$) in AIS, and for the caudate ($p = 0.01$) in PVI. Motor scores did not differ between AIS and PVI thus groups were combined to increase statistical power. Better motor scores were associated with larger non-dominant putamen volumes (BBTA: $r = 0.40$, $p = 0.011$), and larger putamen volume ratios (BBTA: $r = 0.52$, $p < 0.001$, AHA: $r = 0.43$, $p < 0.01$). For those with relatively symmetrical putamen volume ratios (ratio $>$ group mean of 0.8), age was positively correlated with BBTA ($r = 0.54$, $p < 0.01$) and BBTU ($r = 0.69$, $p < 0.001$). For those with more asymmetrical putamen volume ratios, associations with motor function and age were not seen (BBTA: $r = 0.21$, $p = 0.40$, BBTU: $r = 0.37$, $p = 0.13$). Conclusion: Specific perinatal stroke lesions affect different elements of basal ganglia development. PVI primarily affected the caudate, while AIS primarily affected the putamen. Putamen volumes in the lesioned hemisphere are associated with clinical motor function. The basal ganglia should be included in evolving models of developmental plasticity after perinatal stroke.

PMID: [36002972](#)

26. Adverse short- and long-term outcomes among infants with mild neonatal encephalopathy

Vishnu-Priya Akula, Achyuth Sriram, Sherian Xu, Eileen Walsh, Krisa Van Meurs, Matthew Cranshaw, Michael Kuzniwicz

Pediatr Res. 2022 Aug 23. doi: 10.1038/s41390-022-02249-8. Online ahead of print.

Background: Studies in newborns with mild neonatal encephalopathy (mNE) demonstrated normal outcomes, but recent literature suggests otherwise. Methods: This retrospective cohort study examined inborn infants between 2014 and 2017. Biochemical and clinical characteristics determined the presence of NE and an encephalopathy score categorized infants as Definite or Possible mNE. An Unexposed control group consisted of newborns not meeting the inclusion criteria. Long-term outcomes assessed included cerebral palsy, seizures, developmental disorder, and motor and speech delay. The association of mNE with seizure disorder by 3 years of age was assessed with logistic regression and developmental disorders with Cox proportional hazards models. Results: Of the 156,501 births, we identified 130 with Definite mNE and 445 with Possible mNE (0.8 and 2.8 per 1000 births, respectively). Both groups had significantly higher rates of any developmental disorder and motor and speech delay when compared to the Unexposed ($p < 0.05$, except for $p = 0.07$ for motor delay in the Possible NE group). The Definite mNE group had higher rates of developmental disorder and motor and speech delay when compared to the Unexposed with hazard ratios (95% CI) 2.0 (1.2-3.2), 3.7 (1.5-8.8), and 2.1 (1.3-3.5), respectively. Conclusions: An estimate of short- and long-term consequences of mNE suggests that there may be a higher risk of adverse outcome. Impact: Infants with mild NE are at significant risk for adverse short- and long-term outcomes. The risk of having an abnormal long-term outcome at 3 years of age were doubled in the mild NE group compared to the Unexposed group. Randomized clinical trials are needed as neuroprotective strategies may mitigate these.

PMID: [35999380](#)