Cerebral palsy research news

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Interventions and Management

1. Longitudinal development of hand use in children with unilateral spastic cerebral palsy from 18 months to 18 years
Ann-Christin Eliasson, Linda Nordstrand, Magnus Backheden, Marie Holmefur

Dev Med Child Neurol. 2022 Jul 28. doi: 10.1111/dmcn.15370. Online ahead of print.

Aim: To describe the development of the use of the affected hand in bimanual tasks in children with unilateral cerebral palsy (CP) from 18 months to 18 years. Specifically, whether early development can be confirmed in a larger cohort and how development progresses during adolescence. Method: In total, 171 participants (95 males, 76 females; mean age 3 years 1 month [SD 3 years 8 months], range 18 months-16 years at inclusion) were classified in Manual Ability Classification System (MACS) levels I (n = 41), II (n = 91), and III (n = 39). Children were assessed repeatedly (median 7, range 2-16 times) with the Assisting Hand Assessment: in total 1197 assessments. Developmental trajectories were estimated using a nonlinear mixed effects model. To further analyse the adolescent period, a linear mixed model was applied. Results: The developmental trajectories were different between participants in MACS levels (MACS I-II, II-III) in both rate (0.019, 95% confidence interval [CI] 0.006-0.031, p = 0.034; 0.025, 95% CI 0.015-0.037, p < 0.001) and limit (19.9, 95% CI 16.6-23.3, p = 0.001; 7.2, 95% CI 3.3-11.2, p < 0.003). The individual variations were large within each level. The developmental trajectories were stable over time for all MACS levels between 7 and 18 years (p > 0.05). Interpretation: Children and adolescents with unilateral CP have considerable development at an early age and a stable ability to use their affected hand in bimanual activities from 7 to 18 years in all MACS levels.

PMID: 35899928

2. Motor planning is not restricted to only one hemisphere: evidence from ERPs in individuals with hemiplegic cerebral palsy
Neda Sadeghi, Mohammad Taghi Joghataei, Ali Shahbazi, Seyed Hassan Tonekaboni, Hale Akrami, Mohammad Ali Nazari

Exp Brain Res. 2022 Jul 25. doi: 10.1007/s00221-022-06425-4. Online ahead of print.

The evidence for the hemispheric specialization of motor planning reveals several inconsistencies between the left-lateralized hypothesis and a distributed system across the hemispheres. We compared participants with left hemiplegic cerebral palsy (HCP) to right-handed control subjects in this study's first experiment by inviting them to perform a motor planning task. Participants were required to release the start button, grasp a hexagon, and rotate it according to the instructions. In the second experiment, we compared left-HCP subjects with right-HCP subjects inviting them to perform the same task (we used the data for left-HCP subjects from the first experiment). P2 amplitude, as well as planning time, grasping time, releasing time, and initial grip selection planning patterns, were used as outcome measures in both experiments. The first experiment revealed that controls acted more quickly and chose more effective planning patterns. Also, the P2 amplitude was smaller in left-HCP

subjects than in control subjects. No significant group effect was observed in the second experiment for any movement-related measure or P2. At the neural level, however, there was an interaction between 'region' and 'group,' indicating the distinction between the two groups in the right region. The results are discussed in terms of motor planning's hemispheric distribution and individual differences in the HCP group.

PMID: 35876852

3. Comparison of intrathecal baclofen pump insertion and selective dorsal rhizotomy for nonambulatory children with predominantly spastic cerebral palsy

Ann Mansur, Benjamin Morgan, Alexandre Lavigne, Nicolas Phaneuf-Garand, Jocelyne Diabira, Han Yan, Unni G Narayanan, Darcy Fehlings, Golda Milo-Manson, Blythe Dalziel, Sara Breitbart, Claude Mercier, Dominic Venne, Pierre Marois, Alexander G Weil, Jeffrey S Raskin, Sruthi P Thomas, George M Ibrahim

J Neurosurg Pediatr. 2022 Jun 3;1-7. doi: 10.3171/2022.4.PEDS21576. Online ahead of print.

Objective: In nonambulatory children with predominantly spastic cerebral palsy (CP), the authors compared care needs, symptom burden, and complications after surgical treatment with either intrathecal baclofen (ITB) pump insertion or selective dorsal rhizotomy (SDR). The patients were treated at two Canadian centers with variability in practice pertaining to these surgical options. Methods: The authors performed a retrospective analysis of nonambulatory children with predominantly spastic quadriplegic or diplegic CP who underwent treatment with ITB or SDR. These two strategies were retrospectively assessed by comparing patient data from the two treatment groups for demographic characteristics, outcomes, and complications. A partial least-squares analysis was performed to identify patient phenotypes associated with outcomes. Results: Thirty patients who underwent ITB and 30 patients who underwent SDR were included for analysis. Patients in the ITB group were older and had lower baseline functional status, with greater burdens of spasticity, dystonia, pain, deformity, bladder dysfunction, and epilepsy than patients in the SDR group. In addition, children who underwent SDR had lower Gross Motor Function Classification System (GMFCS) levels and were less likely to experience complications than those who underwent ITB. However, children treated with SDR had fewer improvements in pain than children treated with ITB. A single significant latent variable explaining 88% of the variance in the data was identified. Conclusions: Considerable baseline differences exist within this pediatric CP patient population. Factors specific to individual children must be taken into account when determining whether ITB or SDR is the appropriate treatment.

PMID: 35901772

4. Multidimensional Outcomes of Selective Dorsal Rhizotomy for Children With Spastic Cerebral Palsy: Single-Level Laminectomy vs Multiple-Level Laminotomy Techniques

Zhexi He, Sui To Wong, Hing Yuen Law, Lai Mio Miko Lao, Kwai Fong Helen Chan, Nar Chi Nerita Chan, Kwong Yui Yam

Neurosurgery. 2022 Jun 13. doi: 10.1227/neu.0000000000002036. Online ahead of print.

Background: Selective dorsal rhizotomy (SDR) reduces lower limb spasticity, improves gait patterns, and restores normal physical and social activity in children with spastic cerebral palsy. Single-level laminectomy (SLL) and multiple-level laminotomy (MLL) are 2 surgical approaches for SDR with limited clinical data comparing their postoperative outcomes. Objective: To compare the differences in multidimensional outcomes after SDR between SLL and MLL for children with spastic cerebral palsy. Methods: We retrospectively reviewed children who underwent SDR in our hospital from 1997 to 2016. The multidimensional outcomes in spasticity, joint range of motions, gait kinetics, gross motor activities, functional outcomes, and urological outcomes were assessed 1 year postoperatively. Hip dysplasia and scoliosis rate were compared as long-term outcomes. Results: Sixty children underwent SDR, including 34 SLL patients and 26 MLL patients. Most improvements in multidimensional outcomes were comparable between SLL and MLL. Patients in the SLL group had larger improvements in ankle dorsiflexion in the midstance phase (SLL 7.59° ± 11.48° vs MLL 0.29° ± 11.30°, P = .027). The rate of scoliosis was similar between the 2 surgical approaches (SLL 12.1% vs MLL 15.4%, P = .722).

PMID: 35881026

5. [Utility of spinal MRI tractography and spinal MRI angiography in the diagnosis of spastic diplegia] [Article in Russian]
V V Belenky, E A Kozireva, N A Plakhotina, A A Skoromets, P A Dugaev, O V Leontiev, O A Klicenko

Zh Nevrol Psikhiatr Im S S Korsakova. 2022;122(7):151-155. doi: 10.17116/jnevro2022122071151.

There are different views on the nature of cerebral palsy, but no one has been accepted commonly. Since, every new observation of this disorder based on thorough clinical examination could convert the obscurity into clear and simple conception. We report the case of 4-year-old boy with lower paraplegia and speech retardation. The tonus was increased bilaterally in gastrocnemius muscles and thigh adductors. The muscle tonus was decreased in iliopsous. Electrophysiological examination revealed signs of decreased excitability of motoneurons at the level L 2 - S 2. MRI has confirmed lesions of spinal cord at that level in addition to injury at thoracic level and brain lesions. MRI spinal angiography has detected tortuous anterior spinal artery. The boy benefited from the electrophoresis with theophylllinum, applied on lower thoracic and first lumbar vertebrae with improvement of his legs motor skills. Our presentation testifies to involvement of spinal cord and benefits from therapy applied on spine and, thus, confirms the initial description of cerebral palsy in 1853 made by English surgeon James Little.

PMID: 35904307

6. Gait Analysis in Children with Cerebral Palsy: Are Plantar Pressure Insoles a Reliable Tool?
Maria Raquel Raposo, Diogo Ricardo, Júlia Teles, António Prieto Veloso, Filipa João

Sensors (Basel). 2022 Jul 13;22(14):5234. doi: 10.3390/s22145234.

Cerebral palsy (CP) is a common cause of motor disability, and pedobarography is a useful, non-invasive, portable, and accessible tool; is easy to use in a clinical setting; and can provide plenty of information about foot-soil interaction and gait deviations. The reliability of this method in children with CP is lacking. The aim of this study is to investigate test-retest reliability and minimal detectable change (MDC) of plantar pressure insole variables in children with CP. Eight children performed two trials 8 ± 2.5 days apart, using foot insoles to collect plantar pressure data. Whole and segmented foot measurements were analyzed using intraclass correlation coefficients (ICC). The variability of the data was measured by calculating the standard error of measurement (SEM) and the MDC/ICC values demonstrated high test-retest reliability for most variables, ranging from good to excellent (ICC ≥ 0.60). The SEM and the MDC values were considered low for the different variables. The variability observed between sessions may be attributed to the heterogeneous sub-diagnosis of CP.

PMID: 35890913

7. Atypical knee jerk responses in high-risk children: A longitudinal EMG-study
Elisabeth J M Straathof, Elisa G Hamer, Kirsten R Heineman, Mijna Hadders-Algra

Eur J Paediatr Neurol. 2022 Jul 19;40:11-17. doi: 10.1016/j.ejpn.2022.07.003. Online ahead of print.

Introduction: We previously found that atypical responses to the knee jerk reflex, i.e., tonic responses (TRs), clonus and contralateral responses in very high-risk (VHR) infants were associated with cerebral palsy (CP) at 21 months. The current study aimed for a better understanding of pathophysiology of atypical knee jerk responses by evaluating whether infant atypical knee jerk responses are associated with CP and atypical knee jerk responses at school-age. Methods: 31 VHR-children, who had also been assessed longitudinally during infancy, and 24 typically developing children, were assessed at 7-10 years (school -age). We continuously recorded surface EMG of thigh muscles during knee jerk responses longitudinally during infancy and once at school-age. Neurological condition was assessed with age-appropriate neurological examinations. It included the diagnosis of CP at 21 months corrected age and school-age. CP's type and severity (Gross Motor Function Classification System (GMFCS)) were reported. Results: Persistent TRs in infancy were associated with CP at school-age. TR prevalence decreased from infancy to childhood. At school-age it was no longer associated with CP. Clonus prevalence in VHR-children did not change with increasing age; it was significantly higher in children without than those with CP. Reflex irradiation was common in all school-age children, and its prevalence in contralateral muscles in VHR-children decreased between infancy and childhood. Conclusions: In infancy, TRs indicated an increased risk of CP, but at school-age TRs were not associated with CP.

In general, spinal hyperexcitability, expressed as reflex irradiation and TRs, decreased between infancy and school-age.

PMID: 35872514

8. Defining Equinus Foot in Cerebral Palsy
Axel Horsch, Lara Petzinger, Maher Ghandour, Cornelia Putz, Tobias Renkawitz, Marco Götze

Children (Basel). 2022 Jun 25;9(7):956. doi: 10.3390/children9070956.

Background: Equinus foot is the deformity most frequently observed in patients with cerebral palsy (CP). While there is widespread agreement on the treatment of equinus foot, a clear clinical definition has been lacking. Therefore, we conducted this study to evaluate functional changes in gait analysis in relation to maximum possible dorsiflexion (0°, 5°, 10° and 15°) and in two subgroups of CP patients (unilateral and bilateral). Methods: In this retrospective study, CP patients with different degrees of clinically measured maximum dorsiflexion were included. We further subdivided patients into unilaterally and bilaterally affected individuals and also included a healthy control group. All participants underwent a 3D gait analysis. Our goal was to determine the degree of maximum clinical dorsiflexion where the functional changes in range of motion (ROM) and ankle moment and power during gait were most evident. Then, a subgroup analysis was performed according to the affected side. Results: In all, 71 and 84 limbs were analyzed in unilaterally and bilaterally affected subgroups. The clinically 0° dorsiflexion group barely reached a plantigrade position in the 3D gait analysis. Differences in ROM were observed between subgroups. Ankle moment was quite similar between different subgroups but to a lower extent in the unilateral group. All CP patients had reduced ankle power compared to controls. Conclusions: A cutoff value of clinical ≤ 5° dorsiflexion is the recommended value for defining a functionally relevant equinus foot in CP patients.

PMID: 35883940

9. Loaded Functional Strength Training versus Traditional Physical Therapy on Hip and Knee Extensors Strength and Function Walking Capacity in Children with Hemiplegic Cerebral Palsy: Randomized Comparative Study
Hanaa Mohsen Abd-Elfattah, Fairouz Hatem Ameen, Reham Alaa Elkalla, Sobhy M Aly, Noha Ahmed Fouad Abd-Elrahman

Children (Basel). 2022 Jun 24;9(7):946. doi: 10.3390/children9070946.

Objective: This study's objective was to see how loaded functional strengthening exercises using a plantigrade foot position and a shoe supporter affected muscle strength and walking ability in spastic hemiplegic children. Methods: Seventy-two children with spastic hemiplegic cerebral palsy, both sexes, aged ten to twelve years, were randomly assigned into two groups equal in number (control and intervention groups). The control group received a specially designed physical therapy program, whereas the intervention group received a loaded functional strengthening exercises program using a shoe supporter to maintain a plantigrade foot position. The training program was carried out for 60 min, three times per week for three consecutive months. All participants were evaluated both before and after the therapy program by using a Medical Commander Echo Manual Muscle Tester dynamometer to assess isometric muscle power of hip and knee extensors on the affected side. To assess functional walking capacity, a 6 min walking (6MWT) test was used. Results: Study groups were comparable with respect to all outcome measures at entry (p > 0.05). Within-group comparison showed significant improvements in all measured variables. Furthermore, between-group comparison revealed significantly greater improvements (p < 0.05) in hip and knee extensors strength as well as the functional walking capacity in favor of the intervention group. Conclusions: In all the analyzed variables, loaded functional strength exercises from the plantigrade foot position were found to be considerably more effective in the intervention group than in the control group.

PMID: 35883930

10. A core outcome set for lower limb orthopaedic surgery for children with cerebral palsy: An international multi-stakeholder consensus study
Hajar Almoajil, Sally Hopewell, Helen Dawes, Francine Toye, Tim Theologis

Dev Med Child Neurol. 2022 Jul 22. doi: 10.1111/dmcn.15351. Online ahead of print.

Aim: To develop a core set of outcome domains to be measured in clinical studies on lower limb orthopaedic surgery for ambulant children with cerebral palsy (CP) that represents the priorities of an international multi-stakeholder group (children, parent/carers, and health professionals). Method: Potential outcome domains were identified through literature review and qualitative interviews with key stakeholders. These were scored in an international two-round Delphi survey, using a 9-point Likert scale. A final consensus meeting with key stakeholders agreed on the most important outcome domains and refined the core outcome set (COS). Results: One hundred and sixty-one health professionals and 36 individuals with CP and their parents/carers rated 21 of 41 outcomes as important in the Delphi survey. The final consensus group agreed 19 outcomes within eight domains to be included in the final COS: pain and fatigue, lower limb structure, motor function, mobility (daily life activities), gait-related outcomes, physical activity, independence, and quality of life. Interpretation: A COS for lower limb orthopaedic surgery for children with CP was developed. Incorporating this in the design of future clinical studies will provide a more holistic assessment of the impact of treatment while allowing meaningful comparisons and future synthesis of results from primary studies.

PMID: 35869637

11. Computational modelling of ankle-foot orthosis to evaluate spatially asymmetric structural stiffness: Importance of geometric nonlinearity
Wataru Sumihira, Tomohiro Otani, Yo Kobayashi, Masao Tanaka

Proc Inst Mech Eng H. 2022 Jul 23;9544119221114199. doi: 10.1177/09544119221114199. Online ahead of print.

An ankle-foot orthosis (AFO) constructed as a single piece of isotropic elastic material is a commonly used assistive device that provides stability to the ankle joint of patients with spastic diplegic cerebral palsy. The AFO has asymmetric stiffness that restricts plantarflexion during the swing phase while it is flexible to allow dorsiflexion during the stance phase with a large deflection, including buckling originating from geometric nonlinearity. However, its mechanical implications have not been sufficiently investigated. This study aims to develop a computational model of an AFO considering geometric nonlinearity and examine AFO stiffness asymmetry during plantarflexion and dorsiflexion using physical experiments. Three-dimensional AFO mechanics with geometric nonlinearities were expressed using corotational triangle-element formulations that obeyed Kirchhoff-Love plate theory. Computational load tests for plantarflexion and dorsiflexion, using idealised AFOs with two different ankle-region designs (covering or not covering the apexes of the malleoli), showed that plantarflexion moment-ankle angle relationships were linear and dorsiflexion moment-ankle angle relationships were nonlinear; increases in dorsiflexion led to negative apparent stiffness of the AFO. Both ankle-region designs resisted both plantarflexion and dorsiflexion, and out-of-plane elastic energy was locally concentrated on the lateral side, resulting in large deflections during dorsiflexion. These findings give insight into appropriate AFO design from a mechanical viewpoint by characterising three-dimensional structural asymmetry and geometric nonlinearity.

PMID: 35875899

12. Attitudes and Behaviors of Physical Activity in Children with Cerebral Palsy: Findings from PLAY Questionnaire
Dai Sugimoto, Amy E Rabatin, Jodie E Shea, Becky Parmeter, Benjamin J Shore, Andrea Stracciolini

Children (Basel). 2022 Jun 29;9(7):968. doi: 10.3390/children9070968.

To investigate the domains of physical activity in children with cerebral palsy (CP) and to compare these findings to typically developed (TD) children. Methods: A cross-sectional study design. Responses of the four domains in Play Lifestyle and Activity in Youth (PLAY) questionnaire were descriptively analyzed and compared between children with CP (GMFCS I-II) and TD children. Results: Fifty-three children with CP (N = 53, 36 males and 17 females, age of 8.4 ± 1.7 years) and 58 TD children (N = 58, 34 males and 24 females, age of 7.6 ± 1.4 years) participated in this study. In analyses of daily behavior, reported participation in weekly (adaptive) physical education (PE) and sports were more frequent in children with CP (0.6 ± 0.5 days per week) compared to TD children (0.4 ± 0.6 days per week, p = 0.040). Outside play time including free play, organized (adaptive) sports and recess were higher in children with CP (2.7 ± 0.8 days per week) than TD children (2.4 ± 0.7 days per week, p = 0.022). About motivation/attitudes, a higher proportion of TD children feel sad if they are not able to play sports during the day (74.1%) compared to children with CP (48.7%, p < 0.001). Conclusion: Physical activity level was

comparable between children with CP and age-matched TD children, while TD children showed higher scores in knowledge and understanding, motivation/attitudes, and physical competence.

PMID: 35883952

13. Effects of a Modern Kefir on Conditions Associated with Moderate Severe Spastic Quadriparesis Cerebral Palsy
Adán Israel Rodríguez-Hernández, Eva Salinas, Deli Nazmín Tirado González, Carlos Velasco Benitez, Mariela Jiménez, Laura E Córdova-Dávalos, Daniel Cervantes-García, Victor Federico Rodríguez Nava, Luis G Bermúdez-Humarán

Microorganisms. 2022 Jun 25;10(7):1291. doi: 10.3390/microorganisms10071291.

Cerebral palsy (CP) in children constitutes a set of movement and body posture disorders caused by brain injury, which in tum is associated with a series of intestinal, respiratory, and malnutrition conditions. Twenty-four children were selected and included for the present study and subdivided into two groups: (1) children who included modern kefir (containing 12 probiotic species) in their diet; and (2) control group (not including kefir in their diet). The group supplemented with modern kefir received a beverage with multi probiotic species and the control group received commercial yogurt (which included the 2 typical lactic acid bacteria) for 7 weeks. Anthropometric variables, resting energy expenditure, presence, and diagnosis of functional digestive disorders (FDD), frequency of respiratory problems, presence of elevated C-reactive protein, differential count of leukocytes were evaluated. A significant increase in weight and height was found in the kefir group at the final time point. In addition, kefir intake promoted a significant reduction in functional constipation and stool hardness and increased the absolute value of blood lymphocytes. Since the fermented milk beverage modern kefir improves constipation, which is the most important FDD in children with CP and the nutritional and immune status, it could be considered an important strategy to improve health in these children.

PMID: 35889011

14. The utility of bioelectrical impedance analysis to assess nutritional status of patients with severe motor and intellectual disabilities
Nozomu Yano, Daishi Iwashita, Akihiko Ohwatashi

Clin Nutr ESPEN. 2022 Aug;50:191-195. doi: 10.1016/j.clnesp.2022.05.018. Epub 2022 May 30.

Objective: We aimed to evaluate the usefulness of the bioelectrical impedance analysis method in the nutritional assessment of patients with severe motor and intellectual disabilities. Methods: Eighty patients with severe motor and intellectual disabilities were included in the study, and the samples collected were biochemical and body composition data were obtained from regular blood samples and using the bioelectrical impedance analysis method. Nutritional status was scored from the biochemical data, and the subjects were divided into three groups: well-nourished, mildly malnourished, and moderately malnourished. Results: The data that changed significantly with worsening nutritional status were serum albumin, total lymphocyte count, skeletal muscle ratio, phase angle, edema index, and body cell mass normalized by height. There were no significant differences in total lymphocyte count and body cell mass normalized by height between the groups. Discussion: phase angle and edema index, which have been reported to be useful in nutritional assessment, responded sensitively to this nutritional score. Skeletal muscle ratio, which has been reported less frequently, has also been suggested to be useful in the nutritional assessment of severe motor and intellectual disabilities. Conclusion: Low skeletal muscle ratio, low phase angle, and high edema index were significantly suggestive of malnutrition in patients with severe motor and intellectual disabilities, and correlated significantly with biochemical data, a conventional nutritional index. Therefore, bioelectrical impedance analysis is a useful method for nutritional assessment in patients with severe motor and intellectual disabilities.

PMID: 35871923

15. Clinical course of pain intensity in individuals with cerebral palsy: A prognostic systematic review
Heather M Shearer, Leslie Verville, Pierre Côté, Sheilah Hogg-Johnson, Darcy L Fehlings

Review Dev Med Child Neurol. 2022 Jul 24. doi: 10.1111/dmcn.15358. Online ahead of print.

Aim: To describe the clinical course of pain intensity in individuals with cerebral palsy (CP) resulting from usual care or specific interventions. Method: We conducted an exploratory prognostic systematic review searching electronic databases from inception to 31st December 2021. Evidence from low and moderate risk-of-bias studies was synthesized. Results: We retrieved 2275 citations; 18 studies met the inclusion criteria and 10 were synthesized. The course of pain intensity in children with CP receiving usual care was stable over 15 weeks ($\chi 2$ [2] = 1.8, p = 0.5). Children who received continuous intrathecal baclofen (CITB) reported significant pain intensity reduction (visual analogue scale [VAS] = -4.2 out of 10, 95% confidence interval [CI] = -6.3 to -2.1]) 6 months postinsertion but similar children receiving usual care had no significant change over 6 months (VAS = 1.3 out of 10, 95% CI = -1.3 to 3.6). Children receiving botulinum neurotoxin A (BoNT-A) injections had significant decreases in pain after 1 month (numeric rating scale = -6.5, 95% CI = -8.0 to -5.0). Adults with chronic pain receiving usual care reported stable pain intensity over time; pain intensity improved in ambulatory adults exercising and those treated surgically for cervical myelopathy. Interpretation: The course of pain intensity in individuals with CP is unclear. Evidence suggests that children and adults receiving usual care had stable pain intensity over the short or long term. Interventions (CITB and BoNT-A in children and exercise and surgical treatment for cervical myelopathy in adults) had pain intensity reduction. Larger study samples are needed to confirm these results.

PMID: 35871758

16. Mental Health in Pre-Adolescents with Cerebral Palsy: Exploring the Strengths and Difficulties Questionnaire as a Screening Tool in a Follow-Up Study including Multi-Informants

Hanne Marit Bjorgaas, Irene Bircow Elgen, Mari Hysing

Children (Basel). 2022 Jul 6;9(7):1009. doi: 10.3390/children9071009.

There is a high prevalence of mental health problems in children with Cerebral Palsy (CP). Still, knowledge regarding the trajectory of mental health problems throughout childhood and differences according to informants is lacking. There is also a need for more knowledge regarding the validity of mental health screening tools. In the present study, we assessed changes in parent-rated mental health problems in a cohort of 36 children with CP from school-starting age to pre-adolescence and differences in mental health problems according to informants. Further, we assessed the validity of the Strengths and Difficulties Questionnaire (SDQ) for psychiatric disorders. The study cohort was assessed using the SDQ and a child psychiatric diagnostic instrument at school-starting age and at pre-adolescence. Mean parental SDQ scores increased significantly for emotional, hyperactivity and total problems. Self-reported impact of mental health problems was significantly lower than parent-reported impact, and parents and pre-adolescents reported significantly higher mean scores than teachers for emotional problems, conduct problems and total problem scores. Validated against psychiatric disorders, the SDQ was satisfactory for screening children with CP for risk of psychiatric disorders at pre-adolescence. We recommend that mental health screening be integrated into the regular follow-up for children with CP.

PMID: 35883993

17. Establishing a Clinical Brain-Computer Interface Program for Children With Severe Neurological Disabilities

Zeanna Jadavji, Ephrem Zewdie, Dion Kelly, Eli Kinney-Lang, Ion Robu, Adam Kirton

Cureus. 2022 Jun 22;14(6):e26215. doi: 10.7759/cureus.26215. eCollection 2022 Jun.

Background: Children with severe motor impairment but intact cognition are deprived of fundamental human rights. Quadriplegic cerebral palsy is the most common scenario where rehabilitation options remain limited. Brain-computer interfaces (BCI) represent a potential solution, but pediatric populations have been neglected. Direct engagement of children and families could provide meaningful opportunities while informing program development. We describe a patient-centered, clinical, non-invasive pediatric BCI program. Methods: Eligible children were identified within a population-based, tertiary care children's hospital. Criteria included 1) age six to 18 years, 2) severe physical disability (non-ambulatory, minimal hand use), 3) severely limited speech, and 4) evidence of grade 1 cognitive capacity. After initial screening for BCI competency, participants attended regular sessions, attempting commercially available and customized systems to play computer games, control devices, and attempt communication. Results: We report the first 10 participants (median 11 years, range 6-16, 60% male). Over 334 hours of participation, there were no serious adverse events. BCI training was well tolerated, with favorable

feedback from children and parents. All but one participant demonstrated the ability to perform BCI tasks. The majority performed well, using motor imagery based tasks for games and entertainment. Difficulties were most significant using P300, visual evoked potential based paradigms where maintenance of attention was challenging. Children and families expressed interest in continuing and informing program development. Conclusions: Patient-centered clinical BCI programs are feasible for children with severe disabilities. Carefully selected participants can often learn quickly to perform meaningful tasks on readily available systems. Patient and family motivation and engagement appear high.

PMID: 35891842

18. Non-Immersive Virtual Reality as an Intervention for Improving Hand Function and Functional Independence in Children With Unilateral Cerebral Palsy: A Feasibility Study
Chanan Goyal, Vishnu Vardhan, Waqar Naqvi

Cureus. 2022 Jun 19;14(6):e26085. doi: 10.7759/cureus.26085. eCollection 2022 Jun.

Introduction Non-immersive virtual reality (NIVR) is emerging as an advantageous intervention in the arena of neurorehabilitation. Promising results have been obtained by the application of NIVR in adults with various chronic neurological conditions such as stroke and Parkinson's disease, but studies on the use of NIVR in children with unilateral cerebral palsy (CP) are limited. Materials and methods This preliminary study included 10 school-aged participants with unilateral CP who were allocated into experimental and control groups. In accordance with the allocation ratio of 1:1, there were five participants in each group. During six weeks of intervention, children in the experimental group received NIVR intervention in addition to conventional physiotherapy, while those in the control group received only conventional physiotherapy, with a goal to improve hand function and functional independence. Nine-hole peg test (9HPT), box and block test (BBT), ABILHAND kids, and self-care section of functional independence measure for children (WeeFIM) were used as outcome measures. Results There was significant improvement in all outcome measures in both groups. However, the improvement in the hand function and functional independence was significantly more in the experimental group than in the control group. Conclusion It can be concluded that NIVR intervention in the management of children with unilateral CP seems to be feasible and useful. Further research with a larger sample size must be undertaken to reinforce these preliminary findings.

PMID: 35875273

19. Long-term effects of selective fetal growth restriction (LEMON): a cohort study of neurodevelopmental outcome in growth discordant identical twins in the Netherlands
Sophie G Groene, Koen J J Stegmeijer, Ratna N G B Tan, Sylke J Steggerda, Monique C Haak, Femke Slaghekke, Arno A W Roest, Bastiaan T Heijmans, Enrico Lopriore, Jeanine M M van Klink

Lancet Child Adolesc Health. 2022 Jul 21;S2352-4642(22)00159-6. doi: 10.1016/S2352-4642(22)00159-6. Online ahead of print.

Background: Singletons born after fetal growth restriction (FGR) are at increased risk of poor neurodevelopmental outcomes. Studies of singletons with FGR usually compare outcomes with those without FGR, a comparison that is inherently biased by obstetrical, parental, and genetic factors. We aim to compare neurodevelopmental outcomes between the smaller and larger twin in a population of discordant identical twins who shared a single placenta (monochorionic diamniotic), naturally eliminating these confounders. Methods: This study is part of the cohort study LEMON of monochorionic diamniotic twins with selective FGR. All monochorionic diamniotic twins with selective FGR who were born in Leiden University Medical Center (Leiden, Netherlands) between March 1, 2002, and Dec 31, 2017, were eligible for inclusion. Twin pregnancies that were complicated by twin-twin transfusion syndrome, twin anaemia polycythaemia sequence, or monoamnionicity were excluded. Cognitive performance was evaluated with two standardised psychometric age-appropriate tests, producing a full-scale intelligence quotient (FSIQ). Motor functioning was assessed with a standardised neurological examination. A composite outcome of neurodevelopmental impairment (NDI) was used, subdivided into mild NDI (defined as FSIQ <85, minor neurological dysfunction or cerebral palsy grade 1, or mild visual or hearing impairment) and severe NDI (defined as FSIQ <70, severe neurological dysfunction, or severe visual or hearing impairment). Findings: Between Jan 25, 2021, and March 15, 2022, 47 twin pairs were enrolled in the study and underwent neurodevelopmental assessment. The median gestational age at birth was 33·9 weeks (IQR 31·3-36·0) for the 47 included twin pairs, with median birthweights of 1400 g (1111-1875) in the smaller twin and 2003 g (1600-2680) in the larger twin. The median age at neurodevelopmental assessment was 11 years (8-13). Median FSIQ was 94 (86-101) for the smaller twin and 100 (92-108) for the larger twin (p<0·0001). More smaller twins had mild NDI (17 [36%] of 47) than did the larger twins (five [11%] of 47; odds ratio 4·8 [95% CI 1·6-14·1]; p=0·0049). There

was no difference in the proportion of children with severe NDI (two [4%] of 47 in both groups, p=1·0). Interpretation: As mild NDI can impede children in their daily functioning, we recommend standardised long-term follow-up, including neurodevelopmental testing, for monochorionic diamniotic twins with selective FGR to facilitate early identification of children at risk.

PMID: 35871831

20. Epidemiology of Cerebral Palsy among Children and Adolescents in Arabic-Speaking Countries: A Systematic Review and Meta-Analysis
Sami Mukhdari Mushta, Catherine King, Shona Goldsmith, Hayley Smithers-Sheedy, Al-Mamoon Badahdah, Harunor Rashid, Nadia Badawi, Gulam Khandaker, Sarah McIntyre

Review Brain Sci. 2022 Jun 29;12(7):859. doi: 10.3390/brainsci12070859.

Background: Studies on cerebral palsy among children and adolescents in Arabic-speaking countries are scarce. In this systematic review, we aimed to describe the epidemiology of cerebral palsy among children and adolescents in Arabic-speaking countries in terms of prevalence, risk factors, motor types, and rehabilitation. Methods: Six key bibliographic databases were searched for relevant literature published to 17 July 2021. Titles and abstracts were screened for potential inclusion and two independent reviewers screened the full texts of potential articles following pre-defined inclusion/exclusion criteria. The included studies were evaluated independently by three reviewers. The risk of bias was assessed, and data were extracted and analysed. Results: A total of 32 studies from 7 countries met our inclusion criteria. The prevalence of cerebral palsy in Arabic-speaking countries was 1.8/1000 live births (95% CI: 1.2-2.5). Spastic cerebral palsy was the most common motor type, representing 59.8% (95% CI: 46.2-72.7) of pooled estimates. This included children with spastic quadriplegia, diplegia, and hemiplegia; 25.1% (95% CI: 18.2-32.8), 16.2% (95% CI: 11.4-23.3), and 10.4% (95% CI: 7.3-13.8), respectively. Consanguinity was high and represented 37.7% (95% CI: 29.3-46.6). Only one included study reported the types of rehabilitation received (e.g., physiotherapy and assistance devices). Conclusions: This paper provides a summary of the epidemiology of cerebral palsy in Arabic-speaking countries and highlights areas for future research. There is still a substantial knowledge gap on the epidemiology of cerebral palsy in these regions. Countries in the Arab region should follow examples of countries that have successfully established cerebral palsy registries to generate evidence on epidemiology of cerebral palsy and opportunities for prevention.

PMID: 35884667

21. Thinking about differences in the worldwide prevalence of cerebral palsy
Nigel Paneth, Marshalyn Yeargin-Allsopp

Dev Med Child Neurol. 2022 Jul 28. doi: 10.1111/dmcn.15361. Online ahead of print.

PMID: 35899854

22. Editorial: Early Detection and Early Intervention Strategies for Cerebral Palsy in Low and High Resource Settings
Atul Malhotra

Editorial Brain Sci. 2022 Jul 22;12(8):960. doi: 10.3390/brainsci12080960.

No abstract available

PMID: 35892401

23. Activity participation in children and young people with cerebral palsy: A neglected problem in low- and middle-income countries
Edward Kija

Dev Med Child Neurol. 2022 Jul 26. doi: 10.1111/dmcn.15360. Online ahead of print.

No abstract available

PMID: 35891609

24. Perinatalis stroke: vizsgálati irányelv
Eszter Vojcek, István Seri

Review Orv Hetil. 2022 Jun 12;163(24):952-960. doi: 10.1556/650.2022.32472. Print 2022 Jun 12.

Perinatal stroke encompasses a heterogenous group of neurological syndromes due to cerebrovascular diseases, leading to chronic neurological sequelae in most of the cases. Based on pathophysiology, strokes are classified as perinatal arterial ischemic stroke, cerebral sinovenous thrombosis and perinatal haemorrhagic stroke. If not recognized in the neonatal period, the condition usually presents with focal asymmetry between 4-8 months of age and is referred to as presumed perinatal stroke. Nowadays, the increased utilization of magnetic resonance (MR) imaging has resulted in the establishment of an earlier and more accurate diagnosis. The overall incidence of perinatal stroke is ~1 in 1100 live births. Even though neonates with stroke develop normally in 40% of the cases, most patients develop long-term neurological sequalae presenting as cerebral palsy, epilepsy, cognitive impairment, behavioural problems, language delay, visual field defect, hearing loss or a combination of these symptoms. To better understand the condition and predict the outcome, several studies have analysed the associations among risk factors, MR findings and outcome. In this review, we summarize the epidemiology, the imaging modalities, the clinical presentation, and the recommended management strategies as well as the available data on long-term neurodevelopmental outcome. We have also included our proposed management guideline on the diagnosis and management strategies of acute perinatal stroke. Orv Hetil. 2022; 163(24): 952-960.

PMID: 35895561

25. Assessing the Utility of Neonatal Screening Assessments in Early Diagnosis of Cerebral Palsy in Preterm Infants
Rebecca Connors, Vathana Sackett, Catherine Machipisa, Kenneth Tan, Pramod Pharande, Lindsay Zhou, Atul Malhotra

Brain Sci. 2022 Jun 28;12(7):847. doi: 10.3390/brainsci12070847.

Background: Early diagnosis of cerebral palsy (CP) in high-risk infants is possible at 3-4 months' corrected age (CA) using standardised assessments. Aim: To assess the utility of neonatal screening assessments-writhing general movements (GMs) and the Hammersmith Neonatal Neurological Examination (HNNE)-to predict CP/high-risk status at 3-4 months' CA in extremely preterm infants. Methods: Retrospective cohort study of high-risk preterm infants (born < 29 weeks' gestation and/or birth weight < 1000 g) attending an Early Neurodevelopment Clinic. Data from neonatal assessments were compared with CP/high-risk diagnosis at 3-4 months' CA, fidgety GMs, and Hammersmith Infant Neurological Examinations (HINE) using logistic regression, linear regression, and Spearman rank correlation. Results: Two hundred and two preterm infants (median gestation age at birth 27.3 (IQR 25.4-28.3) weeks, mean birth weight 870.3 (SD 248.4) grams) were included. A total of 26 (12.8%) infants received early CP/high-risk diagnoses at 3-4 months' CA. A lower gestational age (GA) (OR = 0.78; p = 0.029, 95% CI [0.26, 0.97]) and abnormal writhing GMs (OR 1.56; p = 0.019, 95% CI [1.07, 2.27]) were predictive of CP/high-risk diagnosis. Although after adjustment for sex, GA, birth weight, and growth restriction, GA (aOR = 0.67; p = 0.068, 95% CI [0.44, 1.03]) and writhing GMs (aOR = 1.44; p = 0.087, 95% CI [0.95, 2.20]) were not significant, a strong trend still persisted. The HNNE scores significantly correlated with both the HINE evaluation (rs = 0.43, p < 0.001, 95% CI [0.31, 0.56]) and fidgety GMs (rs = -0.10, p = 0.012, 95% CI [-0.32, -0.04]). Linear regression confirmed the HNNE was highly predictive of the HINE (correlation coefficient 0.82; p < 0.001, 95% CI [0.48, 1.15]). Writhing GMs did not significantly correlate with either fidgety GMs (p = 0.723, 95% CI [-0.12, 0.17]) or the HINE (p = 0.173, 95% CI [-0.24, 0.04]). Conclusions: Abnormal writhing GMs in the neonatal period were non-significantly associated with early CP/high-risk diagnoses in extremely preterm infants in a multivariate analysis. Additionally, the HNNE significantly correlated with both fidgety GMs and the HINE.

PMID: 35884654

26. Infant massage and brain maturation measured using EEG: A randomised controlled trial
Melissa Lai, Giulia D'Acunto, Andrea Guzzetta, Simon Finnigan, Naoni Ngenda, Robert S Ware, Roslyn N Boyd, Paul B Colditz

Early Hum Dev. 2022 Jul 22;172:105632. doi: 10.1016/j.earlhumdev.2022.105632. Online ahead of print.

Background: Very preterm (VPT) infants develop adverse neurological sequelae from early exposure of the immature brain to the extrauterine environment. Aims: To determine the effects of infant massage on brain maturation in low-risk VPT infants. Study design: A randomised controlled trial of VPT infants, who received standard care or daily massage therapy, administered by the mother, from 34 weeks' to 40 weeks' corrected age (CA). Subjects: VPT infants (born at 28 weeks to 32 + 6 weeks' gestational age, G.A.) and a healthy at term cohort for comparison. Outcome measures: At term equivalent age (39 weeks' to 42 weeks' CA), EEG was recorded to calculate global relative power (GRP), using power spectral analysis. Results: Sixty infants were recruited, and EEGs of 25 massage and 20 standard care infants were analysable. There was no difference between groups in primary outcome (beta GRP). There was a significantly higher central alpha relative power measured in the intervention group infants, compared to standard care (SC) group (mean difference = 1.42, 95 % confidence interval (CI): 0.12 to 2.73; p = 0.03). A massage dose effect was shown by a positive correlation between, massage dose and beta, alpha and theta GRP (r = 0.42, 95%CI = 0.12 to 0.64, r = 0.45; 95%CI = 0.16 to 0.66, r = 0.39; 95%CI = 0.10 to 0.62 respectively) and a negative correlation between massage dose and delta GRP (r = -0.41, 95%CI = -0.64 to -0.12), suggesting that a higher dose of massage is associated with more favourable brain maturation. Conclusions: Central alpha regional relative power was greater in massaged infants compared to SC group infants, suggesting relatively greater brain maturation in this area. A measurable massage dose effect in favour of greater brain maturation, shows promise for verification in a larger clinical trial.

PMID: 35905636

27. Frequency of ulegyria on delayed MRI scans in children with term hypoxic-ischemic injury
Joseph A Stern, Mohamed Elsingergy, Shyam Sunder B Venkatakrishna, Fikadu Worede, Jelena Curic, Savvas Andronikou

Pediatr Radiol. 2022 Jul 27. doi: 10.1007/s00247-022-05445-0. Online ahead of print.

Background: Ulegyria is an under-recognized and underreported potential sequela of hypoxic-ischemic injury (HII) in full-term neonates. Ulegyria is a unique form of parenchymal scarring that leads to a mushroom-shape of the affected gyri resulting from volume loss at the deep portions of the sulci during HII in this specific period in infantile neurodevelopment. Identifying ulegyria is important for ascribing cause and timing of HII on delayed magnetic resonance imaging (MRI) scans and because of its close association with pharmaco-resistant epilepsy. Objective: The purpose of this study was to determine the frequency of ulegyria and characterize the anatomical distribution of watershed injury in a large database of patients who developed cerebral palsy with term HII pattern and underwent delayed MRI. Materials and methods: Patients with term HII patterns on MRI were analyzed for ulegyria. The frequency of ulegyria overall and for each pattern of HII distribution was determined as was the anatomical distribution of watershed injury. Results: Of the 731 children with term HII and cortical injury, 484 (66%) had ulegyria. Ulegyria was most common in those cases with a combined watershed/basal ganglia-thalamic pattern (56%) and isolated watershed pattern (40%). Watershed injury in patients with ulegyria was most common at the posterior watershed (80.6%) and perisylvian watershed (76.7%). Conclusion: Ulegyria was present in nearly two-thirds of patients with term HII and cortical injury and should be sought to support the diagnosis of previous perinatal HII, especially in posterior and perisylvian watershed regions. The implications of ulegyria can be significant for clinical decision-making and for ascribing timing of injury to the perinatal period.

PMID: 35882664

28. Epilepsy syndromes in cerebral palsy: varied, evolving and mostly self-limited
Monica S Cooper, Mark T Mackay, Charuta Dagia, Michael C Fahey, Katherine B Howell, Dinah Reddihough, Susan Reid, A Simon Harvey

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Seizures occur in approximately one third of children with cerebral palsy. This study aimed to determine epilepsy syndromes in children with seizures and cerebral palsy due to vascular injury, anticipating that this would inform treatment and prognosis. We studied a population-based cohort of children with cerebral palsy due to prenatal or perinatal vascular injuries, born 1999-2006. Each child's MRI was reviewed to characterise patterns of grey and white matter injury. Children with syndromic or likely genetic causes of cerebral palsy were excluded, given their inherent association with epilepsy and our aim to study a homogeneous cohort of classical cerebral palsy. Chart review, parent interview and EEGs were used to determine epilepsy syndromes and seizure outcomes. Of 256 children, 93 (36%) had one or more febrile or afebrile seizures beyond the neonatal period and 87 (34%) had epilepsy. Children with seizures were more likely to have had neonatal seizures, have spastic quadriplegic cerebral palsy, and function within Gross Motor Function Classification System level IV or V. Fifty-six (60%) children with seizures had electroclinical features of a self-limited focal epilepsy of childhood (SeLFE); we diagnosed these children with a SeLFE-variant given the current ILAE classification precludes a diagnosis of SeLFE in children with a brain lesion. Other epilepsy syndromes were focal epilepsy - not otherwise specified in 28, infantile spasms syndrome in 11, Lennox-Gastaut syndrome in three, genetic generalised epilepsies in two, and febrile seizures in nine. No epilepsy syndrome could be assigned in seven children with no EEG. Twenty-one changed syndrome classification during childhood. SeLFE-variant usually manifested with a mix of autonomic and brachio-facial motor features, and occipital and/or centro-temporal spikes on EEG. Of those with SeLFE-variant, 42/56 (75%) had not had a seizure for >2 years. Favourable seizure outcomes were also seen in some children with infantile spasms syndrome and focal epilepsy not otherwise specified. Of the 93 children with seizures, at last follow-up (mean age 15 years), 61/91 (67%) had not had a seizure in >2 years. Children with cerebral palsy and seizures can be assigned specific epilepsy syndrome diagnoses typically reserved for normally developing children, those syndromes commonly being age-dependent and self-limited. Compared to typically developing children with epilepsy, SeLFE-variant occurs much more commonly in children with cerebral palsy and epilepsy. These findings have important implications for treatment and prognosis of epilepsy in cerebral palsy, and research into pathogenesis of SeLFE.

PMID: 35871494

Prevention and Cure

29. Retraction: Ultrasound guided neural stem cell transplantation through the lateral ventricle for treatment of cerebral palsy in children

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