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Interventions and Management

1. An Italian Validation of ABILHAND-Kids for Children With Cerebral Palsy

Marco Tofani, Giulia Blasetti, Luca Lucibello, Anna Berardi, Giovanni Galeoto, Maurizio Sabbadini, Luigino Santecchia, Enrico Castelli

Percept Mot Skills. 2021 Oct 5;315125211049730. doi: 10.1177/00315125211049730. Online ahead of print.

Limitations in hand function are common among children with cerebral palsy (CP), with almost 50% presenting an arm-hand dysfunction. However, there is no standardized assessment tool available in Italian for evaluating bimanual performance for this population. Our objective in this study was to evaluate the psychometric properties of an Italian translation of the ABILHAND-Kids (ABILHAND-Kids-IT) among children with CP. We examined internal consistency using Cronbach's Alpha and Omega coefficients, and we investigated test-retest reliability with intraclass correlation coefficients (ICC). We performed explorative factor analysis (EFA) to investigate structural validity. We calculated Pearson's correlation coefficients between the ABILAND-Kids IT and the Manual Ability Classification System (MACS) to assess criterion validity; and, to demonstrate the score variability of the ABILHAND-Kids-IT, we used analyses of variance (ANOVAs) to compare the 181 children with CP in this sample with their levels on the MACS. We enrolled 181 children with CP in the study. EFA confirmed a uni-dimensional scale. We obtained internal consistency on both Cronbach's Alpha and Omega coefficient of 0.98, and a one-week test-retest reliability analysis revealed an ICC with 95% of confidence interval of .992. The ANOVA revealed significant score variability ($p < 0.01$) and the Pearson correlation coefficient comparing the ABILHAND-Kids-It score with the MACS was -0.929 ($p < 0.01$). We conclude that the ABILHAND-Kids-IT is valid and reliable for use with Italian children with CP.

PMID: 34610765

2. No Difference in the Rates of Unplanned Return to the Operating Room Between Magnetically Controlled Growing Rods and Traditional Growth Friendly Surgery for Children With Cerebral Palsy

Margaret Man-Ger Sun, Nicholas J Buckler, Mason Al Nouri, Jason J Howard, Majella Vaughan, Tricia St Hilaire, Paul D Sponseller, John T Smith, George H Thompson, Ron El-Hawary, Pediatric Spine Study Group

J Pediatr Orthop. 2021 Oct 7. doi: 10.1097/BPO.0000000000001892. Online ahead of print.

Background: Early-onset scoliosis (EOS) is common in children with cerebral palsy (CP). The effectiveness of magnetically controlled growing rods (MCGR) and the risk for unplanned return to the operating room (UPROR) remain to be studied in this patient population. The primary outcome of this study was to examine the frequency of UPROR between MCGRs as compared with traditional growth friendly (TGF) surgeries for children with EOS secondary to CP. Methods: Patients with EOS secondary to CP were prospectively identified from an international database, with data retrospectively analyzed.

Scoliosis, kyphosis, T1-S1, and T1-T12 height were measured preoperation, immediate postoperation, and at minimum 2-year follow-up. The risk and etiology of UPRORs were compared between MCGR and TGF. Results: Of the 120 patients that met inclusion criteria, 86 received TGF (age 7.5±0. 1.8 y; mean follow-up 7.0±2.9 y) and 34 received MCGR (age 7.1±2.2 y, mean follow-up 2.8±0.0.5 y). Compared with TGF, MCGR resulted in significant improvements in maintenance of scoliosis (P=0.007). At final follow-up, UPRORs were 8 of 34 patients (24%) for MCGR and 37 of 86 patients (43%) for TGF (P=0.05). To minimize the influence of follow-up period, UPRORs within the first 2 years postoperation were evaluated: MCGR (7 of 34 patients, 21%) versus TGF (20 of 86 patients, 23%; P=0.75). Within the first 2 years, etiology of UPROR as a percentage of all patients per group were deep infection (13% TGF, 6% MCGR), implant failure/migration (12% TGF, 9% MCGR), dehiscence (4% TGF, 3% MCGR), and superficial infection (4% TGF, 3% MCGR). The most common etiology of UPROR for TGF was deep infection and for MCGR was implant failure/migration. Conclusion: For patients with EOS secondary to CP, there was no difference in the risk of UPROR within the first 2 years postoperatively whether treated with TGF surgery or with MCGRs (23% TGF, 21% MCGR).

PMID: 34619723

3. Quality of Surgery and Patient Selection are Keys to Success in Hip Stabilization Surgery in Cerebral Palsy

Janus S H Wong, Evelyn E Kuong, Noah L W So, Abbas Ali, Michael K T To, Wang Chow

J Pediatr Orthop. 2021 Oct 1. doi: 10.1097/BPO.0000000000001961. Online ahead of print.

Background: Cerebral palsy patients are at risk of hip instability, to which various soft tissue and bony surgeries are performed should conservative management fail. We aim to identify factors associated with treatment failure to guide surgical management. Methods: Cerebral palsy patients treated at 2 university-affiliated tertiary pediatric orthopaedic referral centers with hip stabilization surgery performed for subluxation in 1998 to 2015 with minimum of 5 years follow-up were reviewed. Failure was defined as reoperation to the same hip because of recurrent subluxation. Age, sex, Gross Motor Function Classification System level, tone abnormality, operation type, Reimer's migration index (RMI), and acetabular index (AI) were assessed. Cut-off values were identified through Youden index on receiver operating characteristic curve. Results: Eighty-nine hips from 55 patients with mean follow-up of 12.4 years were analyzed. Revision surgery was performed in 14 hips. Postoperative hip subluxation (P<0.001) and acetabular dysplasia (P=0.001) were predictive of failure, with postoperative RMI conferring an adjusted hazard ratio of 1.13 (95% confidence interval: 1.08-1.19, P<0.001) on multivariable survival analysis. Achieving a postoperative RMI of <27.5% predicts success with 92.9% sensitivity and 72% specificity with area under curve of 0.916 (P<0.001), while postoperative AI of <23.1 degrees predicts success with 92.3% sensitivity and 62.2% specificity with area under curve of 0.796 (P=0.001). In subgroup analysis of soft-tissue-only procedures, RMI >44% preoperative and >32% postoperative were associated with reoperation. In femur-only osteotomies, preoperative RMI >48% and postoperative RMI >28% were associated with failure. In pelvic and combined osteotomies, postoperative RMI >32% and AI >30 degrees were associated with failure. Other factors analyzed were not associated with reoperation. Conclusions: Patient selection and quality of surgery in terms of residual postoperative hip subluxation and acetabular dysplasia are associated with need for remedial surgery. Soft-tissue-only procedures should aim to correct RMI to <32%. Bony surgery should be considered when preoperative RMI >44%, and pelvic osteotomies if RMI >48%. Pelvic osteotomies should target postoperative RMI <32% and AI <30 degrees. Level of evidence: Level II-prognostic study.

PMID: 34608041

4. Muscle synergy structure and gait patterns in children with spastic cerebral palsy

Marije Goudriaan, Eirini Papageorgiou, Benjamin R Shuman, Katherine M Steele, Nadia Dominici, Anja Van Campenhout, Els Ortibus, Guy Molenaers, Kaat Desloovere

Dev Med Child Neurol. 2021 Oct 6. doi: 10.1111/dmcn.15068. Online ahead of print.

Aim: To determine if muscle synergy structure (activations and weights) differs between gait patterns in children with spastic cerebral palsy (CP). Method: In this cross-sectional study, we classified 188 children with unilateral (n=82) or bilateral (n=106) spastic CP (mean age: 9y 5mo, SD: 4y 3mo, range: 3y 9mo-17y 7mo; 75 females; Gross Motor Function Classification System [GMFCS] level I: 106, GMFCS level II: 55, GMFCS level III: 27) into a minor deviations (n=34), drop foot (n=16), genu recurvatum (n=26), apparent equinus (n=53), crouch (n=39), and jump gait pattern (n=20). Surface electromyography recordings from eight lower limb muscles of the most affected side were used to calculate synergies with weighted non-negative matrix factorization. We compared synergy activations and weights between the patterns. Results: Synergy structure was similar between gait patterns, although weights differed in the more impaired children (crouch and jump gait) when compared to the other patterns. Variability in synergy structure between participants was high. Interpretation: The similarity in synergy structure between gait patterns suggests a generic motor control strategy to compensate for the brain lesion. However, the differences in weights and high variability between participants indicate that this generic motor control strategy might be individualized and dependent on impairment level.

PMID: 34614213

5. The effect of a low-load plyometric running intervention on leg stiffness in youth with cerebral palsy: A randomised controlled trial

A Chappell, G T Allison, N Gibson, G Williams, S Morris

Gait Posture. 2021 Sep 24;90:441-448. doi: 10.1016/j.gaitpost.2021.09.194. Online ahead of print.

Aim: To determine whether a running intervention utilising plyometric activities improved leg stiffness in youth with cerebral palsy (CP), GMFCS levels I and II. Method: This stratified randomised controlled trial examined the lower limb kinetics and kinematics of a sample of youths with CP during sub-maximal hopping and running, prior to and immediately following a 12-week running intervention that incorporated low load plyometric training. Included participants were 13 in the control group (mean age 13 years 2 months [SD 2 years 7 months]; six males; nine GMFCS level I; six unilateral) and 18 in the intervention group (mean age 12 years 9 months [SD 2 years 10 months]; 13 males; 11 GMFCS level I; nine unilateral). Derived variables included three-dimensional leg stiffness as well as resultant ground reaction force and change in leg length. Generalised linear mixed models were developed for statistical analysis. Results: At follow-up the intervention group had greater leg stiffness than the control group during submaximal hopping (Intervention median = 3278Nm-1; Control median = 1556Nm-1; $p < 0.01$). At follow-up, participants in the intervention group in GMFCS Level I had greater leg stiffness than the control group during jogging (Intervention mean=38.84 (SD=25.55); Control mean=29.38 (SD=11.11); $t = 2.61$ $p = 0.01$). Interpretation: A running training intervention which includes plyometric activities can improve leg stiffness in young people with CP, especially those in GMFCS level I.

PMID: 34600178

6. Descriptive contents analysis of ParticiPAte CP: a participation-focused intervention to promote physical activity participation in children with cerebral palsy

Sarah E Reedman, Lakshmi Jayan, Roslyn N Boyd, Jenny Ziviani, Catherine Elliott, Leanne Sakzewski

Disabil Rehabil. 2021 Oct 8;1-11. doi: 10.1080/09638288.2021.1985636. Online ahead of print.

Purpose: ParticiPAte CP is a participation-focused therapy intervention that is effective to increase perceived performance of physical activity (PA) participation goals in children with cerebral palsy (CP). We aimed to characterise the contents of ParticiPAte CP using validated behaviour change frameworks. Materials and methods: Data came from physiotherapist treatment notes and were used to specify: (1) physiotherapist-perceived barriers to behaviour change (using the International Classification of Functioning, Disability and Health Framework [ICF] and Theoretical Domains Framework), intervention content (Behaviour Change Technique Taxonomy v1), intervention functions (Behaviour Change Wheel) and mechanisms of action (Capability, Opportunity, Motivation - Behaviour model). Results: Physiotherapist-perceived barriers to participation were identified in all ICF and Theoretical Domains Framework domains. ParticiPAte CP consisted of 32 behaviour change techniques, delivered via six intervention functions of the Behaviour Change Wheel, especially enablement. All six possible mechanisms of action were identified according to the Capability, Opportunity, Motivation - Behaviour model. These were targeted most frequently through Theoretical Domains Framework domains social influences, environmental context and resources, intentions, skills, knowledge, and beliefs about capabilities. Conclusions: The content of a PA intervention for children with CP can be specified according to behaviour change frameworks. ParticiPAte CP was complex, with multiple targets, constituent behaviour change techniques and mechanisms of action. Trial Registration: Australian New Zealand Clinical Trials Registry ACTRN12615001064594.Implications for rehabilitation: Providing social support to families through practical actions such as motivating conversation, providing information, linking families to community services and participating in activities with children to support their self-efficacy may be a defining feature of effective participation-focused therapies. If children with cerebral palsy (CP) and their families nominate goals for increased frequency of attendance or improved involvement in physical activities (PAs), therapists must identify all important barriers to participation, including behavioural barriers that may be thought of less often (e.g. emotions, beliefs, optimism etc.).Promoting PA participation in children with CP may require a complex or multi-faceted therapy intervention that supports not only physical capability, but also enhances the social and physical opportunity for participation to take place and promotes the psychological capability and motivation for PA of children and families. Therapists or researchers may consider using the Behaviour Change Wheel to prospectively design their own health behaviour intervention for children with CP.

PMID: 34624202

7. Assessment of dental caries in children with organic lesions of the nervous system using ICDAS II criteria
Khrystyna Vasylivna Pryimak, Iryna Anatoliivna Zoriy, Nataliia Vasylivna Bidenko, Anatoliy Vasylovych Borysenko, Viktor Markiyanovich Batig, Tetiana Anatoliyivna Hlushchenko, Iryna Viktorivna Batih, Michael Ivanovich Sheremet

J Med Life. Jul-Aug 2021;14(4):570-577. doi: 10.25122/jml-2020-0155.

Studies of the dental status of children with cerebral palsy (CP) indicate a high prevalence and intensity of damage to the hard tissues of the teeth. The risk of developing dental diseases is known to increase significantly as the severity of neurological symptoms increase. The purpose of the study was to assess the incidence of dental caries using the International Caries Detection and Assessment System (ICDAS II) criteria in children with organic diseases of the nervous system depending on the severity of motor impairment. A number of 122 children (mean age 8.8±3.7 years) with spastic forms of cerebral palsy were examined. They were divided into groups according to the Gross Motor Function Classification System - Expanded & Revised (GMFCS-ER). All patients underwent a neurological examination, and the state of dental caries was determined using the ICDAS II criteria. In children with cerebral palsy, lesions of the occlusal surfaces of the teeth predominate, lesions of the proximal surfaces appeared to be three times less, but more than three times higher than in healthy children. Higher intensity of the carious process and the frequency of deep cavities are observed in children with cerebral palsy with severe motor impairment, according to GMFCS-ER. Establishing the features of caries development in children with cerebral palsy depending on the severity of neurological symptoms according to the ICDAS II system is an essential factor in determining the direction of preventive measures that should be taken for this group of children.

PMID: 34621384

8. Parental perception of oral health related quality of life and barriers to access dental care among children with intellectual needs in Kottayam, central Kerala-A cross sectional study
Jeeva Puthiyapurayil, T V Anupam Kumar, Gibi Syriac, Maneesha R, Raseena Kt, Najmunnisa

Spec Care Dentist. 2021 Oct 6. doi: 10.1111/scd.12658. Online ahead of print.

Aim: To evaluate the parental perception of oral health related quality of life and barriers to access dental care among children with intellectual needs. Method: This cross sectional study was conducted among randomly selected 300 parents of children aged 4-12 years with intellectual needs (mental retardation, cerebral palsy, epilepsy, autism). Data on oral health related quality of life (OHRQoL) were collected with parental-caregivers perceptions questionnaire (P-CPQ). DMFT/dmft index was used to express caries prevalence as per World Health Organisation. Chi-squared test, analysis of variance, t-test and correlation were performed. Results: Parents of children who fell in the high severity DMFT category reported higher score in all four domains of OHRQoL when compared to low severity and moderate severity. Parents of children suffering from autism had higher score in all four domain of OHRQoL ($p = .000$).Majority of the parents rated their children's oral health as either fair (47%) or poor (42%). Predominant barriers for access dental care were financial difficulties (35.3%), lack of knowledge about dental care (24%), transportation difficulties (15%). Conclusion: The present study revealed that higher caries prevalence has negative impact on OHRQoL of children with intellectual needs and their parents faced certain barriers for accessing dental care.

PMID: 34614254

9. Establishing consensus for the assessment of chronic pain in children and young people with cerebral palsy: a Delphi study
Adrienne R Harvey, Clare T McKinnon, Nadine Smith, Katarina Ostojic, Simon P Paget, Suzanne Smith, Daisy A Shepherd, Jenny Lewis, Angie Morrow

Disabil Rehabil. 2021 Oct 6;1-6. doi: 10.1080/09638288.2021.1985632. Online ahead of print.

Purpose: Inconsistent and inadequate pain assessment practices in cerebral palsy (CP) have resulted from a lack of standardisation of pain assessment, limited use of appropriate tools and failure to integrate disability and biopsychosocial models. To assist with improving consistency, this study aimed to establish consensus from key stakeholders regarding domains considered essential for measuring chronic pain in children and young people with CP. Method: A modified electronic Delphi study was conducted on 83 stakeholders, including clinicians, researchers, people with CP and parents of children with CP. Participants rated 18 domains sourced from existing literature as either "core", "recommended", "exploratory" or "not required". Results: After two rounds of surveys, 12 domains were considered core: pain location, pain frequency, pain intensity, changeable factors, impact on emotional wellbeing, impact on participation, pain communication, influence on quality of life, physical impacts, sleep, pain duration and pain expression. Conclusion: These domains reflect the complexity of pain in a heterogeneous population where medical comorbidities are common and communication and intellectual limitations impact significantly on the ability of many to self-report. The domains will be utilised to build a framework of pain assessment specific to children and young people with CP guided by the biopsychosocial model. Implications for rehabilitation: Chronic pain is under-identified and poorly assessed in the cerebral palsy (CP) population. The perspectives of clinicians, researchers and consumers are vital for developing a framework for chronic pain assessment in CP. Consensus of key stakeholders found 12 domains considered essential to incorporate into a chronic pain assessment model in CP.

PMID: 34613866

10. Mental health and behaviour in children with dystonia: Anxiety, challenging behaviour and the relationship to pain and self-esteem

Lauren Bates, Michelle Taylor, Jean-Pierre Lin, Hortensia Gimeno, Jessica Kingston, Sarah R Rudebeck

Eur J Paediatr Neurol. 2021 Sep 14;35:40-48. doi: 10.1016/j.ejpn.2021.09.002. Online ahead of print.

Purpose: To ascertain whether young people with dystonia are more likely than the general population to have mental health and/or behavioural difficulties, and to explore factors that may contribute to these difficulties. Method: Using a quasi-experimental design, 50 young people with dystonia aged 7-17 and their carers were recruited from the Evelina London Children's Hospital. Young people completed the Beck Youth Inventories and the Strengths and Difficulties Questionnaire. Carers completed the Strengths and Difficulties Questionnaire-Parent version and the Paediatric Pain Profile. Important medical factors, such as age of onset, motor severity and manual function were obtained from medical records. Results: One sample z tests showed young people with dystonia self-reported significantly higher levels of anxiety ($p < .001$) and prosocial difficulties ($p < .01$), with 48% experiencing clinically significant anxiety levels. They experienced significantly lower levels of anger, disruptive behaviour and conduct problems (all $p \leq .01$). Carers reported significantly higher rates of emotional problems, hyperactivity and peer problems, and significantly lower prosocial behaviours (all $p \leq .01$). Pearson's correlation coefficients showed lower levels of self-esteem were related to higher levels of anxiety ($p = .015$). High levels of pain were related to parent-rated conduct problems ($p = .004$). Age of dystonia onset and motor severity did not correlate with any of the psychological or behavioural measures. Interpretation/conclusions: Our study suggests high rates of anxiety and behaviours that challenge in children with dystonia. Screening in movement clinics would be helpful in early identification and signposting for support.

PMID: 34600412

11. Efficacy of hand-arm bimanual intensive therapy including lower extremities (HABIT-ILE) in young children with bilateral cerebral palsy (GMFCS III-IV) in a low and middle-income country: protocol of a randomised controlled trial

Emmanuel Segnon Sogbossi, Solange Sotindjo Adon, Leontine Adjagodo, Solange Dossou, Hyppolite Dakè, Daniela Ebner-Karestinos, Rodrigo Araneda, Geoffroy Saussez, Julie Paradis, Toussaint G Kpadonou, Yannick Bleyenheuft

BMJ Open. 2021 Oct 5;11(10):e050958. doi: 10.1136/bmjopen-2021-050958.

Introduction: Cerebral palsy (CP) is highly prevalent in sub-Saharan Africa, where clinically-based studies have shown a considerable over-representation of the severe bilateral subtype. However, children's access to rehabilitation care is limited by many local factors, notably the lacking of rehabilitation services, insufficient knowledge of caregivers and financial constraints. In such a context there is an urgent need for studies of the evidence-based rehabilitation approach. Here, we describe the protocol of a randomised controlled study to investigate the efficacy of Hand-Arm Bimanual Intensive Therapy Including the Lower Extremities (HABIT-ILE) in young children with bilateral CP in Benin Republic, a representative low and middle-income country of western Africa. Methods and analysis: Forty children with bilateral CP aged between 24 and 59 months and with level III-IV in the gross motor function classification will be randomised to either a high intensity conventional therapy or HABIT-ILE therapy. Both therapies will be delivered as a day-camp model over 2 weeks to a total of 50 hours (5 hours per day). The assessor-blinded primary outcomes will include the gross motor function measure and both hands assessment. Secondary outcomes will be the adapted version of the ACTIVLIM-CP questionnaire, the Canadian Occupational Performance Measure, and a perception of CP interview form. Children will be assessed at baseline, after intervention and at 6-week follow-up. A 2 (group)×3 (test sessions) repeated analysis of variance will evaluate changes after the interventions. Ethics and dissemination: This study has been approved by the ethics committee of the rehabilitation department of the National Teaching Hospital Hubert Koutoukou Maga of Cotonou, Benin (approval decision: N°01-2019/MS/CNHU-HKM/CEI/CUMPR). All participants' parents/caregivers will provide their written informed consent. Data will be managed with confidentiality. Trial registration number: PACTR201911894444879.

PMID: 34610941

12. Physical therapy in children with cerebral palsy in Brazil: a scoping review
Michelle A S Furtado, Kênnea M A Ayupe, Isabella S Christovão, Ricardo R Sousa Junior, Peter Rosenbaum, Ana C R Camargos, Hércules R Leite

Review Dev Med Child Neurol. 2021 Oct 2. doi: 10.1111/dmcn.15067. Online ahead of print.

Aim: To identify and assess published studies concerning physical therapy in Brazilian children and adolescents with cerebral palsy (CP) using the International Classification of Functioning, Disability and Health (ICF) framework. Method: Articles in English and Portuguese published until October 2020, with no date restrictions, were searched in several different databases. Study characteristics, journal metrics, sample characteristics, and ICF domains explored intervention components and outcomes were extracted. Studies were classified according to the Oxford Centre for Evidence-Based Medicine hierarchy levels to characterize the evidence. Results: Ninety-four studies were included. Spastic CP with fewer limitations in gross motor abilities was the most reported; 67% of the studies had low levels of evidence and were published in journals without an impact factor. The three most frequent interventions were neurodevelopmental treatment, suit therapy, and transcranial direct current stimulation. Intervention components explored body functions and structures (73.4%), activity (59.6%), environment (2.1%). They did not explore participation (0%). The outcomes investigated addressed activity (79.8%), body functions and structures (67.0%), and participation (1.1%), but not environment (0%). Interpretation: Studies of physical therapy for Brazilian children and adolescents with CP focused on reducing impairments and activity limitations. Studies with higher levels of evidence and an expanded focus on participation and environmental factors are necessary.

PMID: 34601719

13. Promoting functional development for children with cerebral palsy in low-income countries
Cally J Tann

Dev Med Child Neurol. 2021 Oct 5. doi: 10.1111/dmcn.15082. Online ahead of print.

PMID: 34608988

14. Expression of and correlational patterns among neuroinflammatory, neuropeptide, and neuroendocrine molecules from cerebrospinal fluid in cerebral palsy
Cory J Goracke-Postle, Chantel C Burkitt, Angela Panoskaltsis-Mortari, Michael Ehrhardt, George L Wilcox, Patrick Graupman, Michael Partington, Frank J Symons

BMC Neurol. 2021 Oct 4;21(1):384. doi: 10.1186/s12883-021-02333-2.

Background: The underlying pathogenesis of cerebral palsy (CP) remains poorly understood. The possibility of an early inflammatory response after acute insult is of increasing interest. Patterns of inflammatory and related biomarkers are emerging as potential early diagnostic markers for understanding the etiologic diversity of CP. Their presence has been investigated in plasma and umbilical cord blood but not in cerebrospinal fluid (CSF). Methods: A clinical CP sample was recruited using a single-time point cross-sectional design to collect CSF at point-of-care during a standard-of-care surgical procedure (intrathecal pump implant). Patient demographic and clinical characteristics were sourced from medical chart audit. Results: Significant ($p \leq 0.001$) associations were found among neuroinflammatory, neuroendocrine, and nociceptive analytes with association patterns varying by birth status (term, preterm, extremely preterm). When between birth-group correlations were compared directly, there was a significant difference between preterm and extremely preterm birth subgroups for the correlation between tumour necrosis factor alpha (TNFα) and substance P. Conclusion: This investigation shows that CSF can be used to study proteins in CP patients. Differences in inter-correlational patterns among analytes varying by birth status underscores the importance of considering birth status in relation to possible mechanistic differences as indicated by biomarker signatures. Future work should be oriented toward prognostic and predictive validity to continue to parse the heterogeneity of CP's presentation, pathophysiology, and response to treatment.

PMID: 34607558

15. Association of ApoE Genotypes and Recovery From Intracerebral Hemorrhage in Very Low Birth Weight Infants

Alexander Humberg, Mark Dzietko, Sören Schulz, Ursula Felderhoff-Müser, Britta Hüning, Anja Stein, Mats I Fortmann, Janina Marissen, Tanja K Rausch, Egbert Herting, Christoph Härtel, Wolfgang Göpel, German Neonatal Network (GNN)

Stroke. 2021 Oct 8;STROKEAHA120033432. doi: 10.1161/STROKEAHA.120.033432. Online ahead of print.

Background and purpose: Associations of APOE genotypes with intracerebral hemorrhage (ICH) in preterm infants were previously described. In adults, APOE-ε4 genotype has been proposed as susceptibility factor for impaired recovery after cerebral insult. We here aim to determine APOE genotype-specific neurological consequences of neonatal ICH at school age. Methods: In this multicenter observational cohort study, very low birth weight (<1500 g, <32 weeks gestational age) children were studied for cerebral palsy (CP) after ultrasound diagnosed ICH stratified by APOE genotype. Follow-up examination was done at the age of 5 to 6 years. Study personnel were blinded for perinatal information and complications. Participants were born between January 1, 2009 and December 31, 2013 and enrolled in the German Neonatal Network. Of 8022 infants primarily enrolled, 2467 children were invited for follow-up between January 1, 2014 and December 31, 2019. Univariate analyses and multivariate logistic regression models were used to assess the impact of APOE genotype (APOE-ε2, APOE-ε3, APOE-ε4) on CP after ICH. Results: Two thousand two hundred fifteen children participated at follow-up, including 363 children with ultrasound diagnosed neonatal ICH. In univariate analyses of children with a history of ICH, APOE-ε3 carriers had lower frequencies of CP (n=33/250; 13.2 [95% CI, 9.4%-17.8%]), as compared to APOE-ε2 (n=15/63; 23.8 [14.6%-35.3%], P=0.037) and -ε4 carriers (n=31/107; 29.0 [21.0%-38.0%], P<0.001), respectively. Regression models revealed an association of APOE-ε4 genotype and CP development (odds ratio, 2.77 [1.44-5.32], P=0.002) after ICH. Notably, at low-grade ICH (grade I) APOE-ε4 expression resulted in an increased rate of CP (n=6/39; 15.4 [6.7-29.0]) in comparison to APOE-ε3 (n=2/105; 1.9 [0.4%-6.0%], P=0.002). Conclusions: APOE-ε4 carriers have an increased risk for long-term motor deficits after ICH. We assume an effect even after low-grade neonatal ICH, but more data are needed to clarify this issue.

PMID: 34619984

16. [Abusive Head Trauma][Article in Japanese]

Takashi Araki

No Shinkei Geka. 2021 Sep;49(5):1011-1023. doi: 10.11477/mf.1436204484.

Abusive head trauma (AHT) is a leading cause of severe traumatic brain injury in children under 2 years old. Patients with AHT present with various clinical features, including acute subdural hematoma, retinal hemorrhage, and extensive hemispheric hypodensity, which has recently been reproduced in a basic experimental model. Despite multidisciplinary treatment, the outcome is poor, and neurological sequelae often remain. However, functional recovery seems possible with aggressive rehabilitation. The medical rationale for the diagnosis of AHT has a significant impact on the judicial decision-making process to determine evidence of child abuse, enabling collaboration with the police, prosecutors, and other investigative agencies,

including lawyers. In Japan, infantile acute subdural hematoma(hematoma type I)is a clinical form of hematoma that often occurs after 6-10 months, when the child is able to walk. It is accompanied by backward fall, sudden loss of consciousness, pallor, spastic paralysis of the extremities, and retinal hemorrhage. A nationwide survey of infant acute subdural hematoma due to minor injury is currently being planned, and it is hoped that this would be comprehensive in Japan. Medical personnel involved in neurosurgical emergencies have an important responsibility as a safety network for pediatric care and are expected to play a central role in the diagnosis of AHT through collaboration with many specialized departments.

PMID: 34615761

17. Early Biomarkers of Hypoxia and Inflammation and Two-Year Neurodevelopmental Outcomes in the Preterm Erythropoietin Neuroprotection (PENUT) Trial

Thomas R Wood, Pratik Parikh, Bryan A Comstock, Janessa B Law, Theo K Bammler, Karl C Kuban, Dennis E Mayock, Patrick J Heagerty, Sandra Juul, PENUT Trial consortium

EBioMedicine. 2021 Oct 4;72:103605. doi: 10.1016/j.ebiom.2021.103605. Online ahead of print.

Background: In the Preterm Erythropoietin (Epo) NeUroproTection (PENUT) Trial, potential biomarkers of neurological injury were measured to determine their association with outcomes at two years of age and whether Epo treatment decreased markers of inflammation in extremely preterm (<28 weeks' gestation) infants. Methods: Plasma Epo was measured (n=391 Epo, n=384 placebo) within 24h after birth (baseline), 30min after study drug administration (day 7), 30min before study drug (day 9), and on day 14. A subset of infants (n=113 Epo, n=107 placebo) had interferon-gamma (IFN-γ), Interleukin (IL)-6, IL-8, IL-10, Tau, and tumour necrosis factor-α (TNF-α) levels evaluated at baseline, day 7 and 14. Infants were then evaluated at 2 years using the Bayley Scales of Infant and Toddler Development, 3rd Edition (BSID-III). Findings: Elevated baseline Epo was associated with increased risk of death or severe disability (BSID-III Motor and Cognitive subscales <70 or severe cerebral palsy). No difference in other biomarkers were seen between treatment groups at any time, though Epo appeared to mitigate the association between elevated baseline IL-6 and lower BSID-III scores in survivors. Elevated baseline, day 7 and 14 Tau concentrations were associated with worse BSID-III Cognitive, Motor, and Language skills at two years. Interpretation: Elevated Epo at baseline and elevated Tau in the first two weeks after birth predict poor outcomes in infants born extremely preterm. However, no clear prognostic cut-off values are apparent, and further work is required before these biomarkers can be widely implemented in clinical practice. Funding: PENUT was funded by the National Institute of Neurological Disorders and Stroke (U01NS077955 and U01NS077953).

PMID: 34619638

18. Epilepsy and Neurodevelopmental Outcomes in a Cohort of West Syndrome Beyond Two Years of Age

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Objective: To determine epilepsy and neurodevelopmental outcomes beyond 2 y of age and their putative prognostic factors in children with West syndrome (WS). Methods: This cross-sectional study was initiated after approval from Institutional Ethics Committee. A follow-up cohort of 114 children (aged ≥ 2 y) diagnosed and treated for WS at the authors' center were assessed in-person for epilepsy and neurodevelopmental outcomes using Vineland Social Maturity Scale - Malin's adaptation for Indian children. Subsequently, age at onset, lead-time-to-treatment, etiology, and response to any of the standard therapies were analyzed as possible predictors of these outcomes. Results: Of 114 children (mean age: 55 ± 32 mo, 91 boys), structural etiology was the predominant underlying etiology (79.8%) for WS. At 2 y of age, 64% had ongoing seizures. At the last follow-up, 76% had social quotient < 55, and 39% had cerebral palsy (spastic quadriparesis in 21%). An underlying structural etiology was associated with ongoing seizures [OR (95% CI) 3.5 (1.4-9); $p = 0.008$] at 2 y of age and poor developmental outcomes [OR (95% CI): 3.3 (1.3-8.9); $p = 0.016$]. Complete cessation of spasms with the standard therapy was significantly associated with better seizure control [OR (95% CI): 5.4 (2.3-13); $p < 0.001$] and neurodevelopmental outcome [OR (95% CI): 5.2 (1.8-14.9); $p < 0.001$]. Conclusion: The majority of children with WS have a poor neurodevelopmental outcome and epilepsy control on follow-up. The underlying etiology and response to initial standard therapy for epileptic spasms have a prognostic role in predicting the neurological outcome in these patients on follow-up.

PMID: 34623615

19. Parental engagement in early intervention for infants with cerebral palsy - A realist synthesis
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Review Child Care Health Dev. 2021 Oct 8. doi: 10.1111/cch.12916. Online ahead of print.

Background: Emphasis on parental engagement strategies within occupational therapy and physiotherapy early intervention (EI) programmes for infants at high risk of cerebral palsy (CP) has increased. This reflects consensus that increasing parent participation enhances treatment efficacy, potentially improving infant and parent outcomes. However, evaluation of parental engagement in EI is complex. Despite the growing application of parental engagement strategies, aligned with family-centred care practice, theoretical evaluation is currently lacking within the literature. This realist synthesis aimed to identify component theories underlying EI strategies to support parental engagement and to use empirical findings to evaluate how these work in practice. Methods: Realist synthesis. Databases Medline, Embase, Amed, CINAHL and PsychInfo were searched (from 1985-February week 1 2020); further articles were sourced from reference lists. A data extraction form was used and a Critical Appraisal Skills Programme tool was used to assess study rigour. Results: Twenty-six articles were included. Quality of relationships, parent education and intervention co-design were the key themes related to parental engagement strategies. Findings indicate that constructive parent reasoning mechanisms of trust, belief, sense of control, perceived feasibility of home programme delivery and ultimately motivation, are linked to the underlying intervention resources afforded by specific strategies, (e.g. coaching pedagogy). These responses are precursors to engagement outcomes that include increased parental self-efficacy and adherence. Importantly, parental self-efficacy can initiate a process of change leading to improved parental confidence and anxiety. Conclusion: Sensitively designed programme strategies, centred on relational quality between parent, infant and therapist, are fundamental for effective parent connection, involvement and investment within EI for infants with CP.

PMID: 34622968

20. Effects of minimally invasive surgery and functional physiotherapy on motor function of children with cerebral palsy: A non-randomised controlled trial
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Purpose: This non-randomised controlled trial investigated whether a combined programme of functional physiotherapy and minimally invasive orthopaedic surgery improves the level and degree of capacity and performance of gross motor function in children with spastic cerebral palsy (CP). Methods: Fifty-two children with spastic CP aged 5-7 years, Gross Motor Function Classification System (GMFCS) levels II-IV, were allocated to two equal groups: experimental group (selective percutaneous myofascial lengthening [SPML] procedure and 9-month functional strengthening physiotherapy programme) and control (standard physiotherapy) groups. At baseline and at the end of the 9-month intervention, the capacity and performance of gross motor function were assessed with the Gross Motor Function Measure (GMFM) D and E subcategories and Functional Mobility Scale (FMS), respectively. The level of gross motor function was measured with the GMFCS. Results: There was a statistically significant difference in the post-intervention improvements in the GMFM D (experimental mean difference = 19.63 ± 10.46; control mean difference = 2.40 ± 4.62) and E (experimental mean difference = 19.33 ± 11.82; control mean difference = 4.20 ± 6.26) between experimental and control group ($p < 0.001$). There was a significant improvement in the GMFCS level and each FMS distance for the experimental group ($p < 0.001$), but not for the control group ($p > 0.05$). Conclusion: SPML procedure combined with functional physiotherapy improves gross motor function in children with spastic CP, by raising the degree and level of motor independence.

PMID: 34616116

21. Brain functional reorganization in children with hemiplegic cerebral palsy: Assessment with TMS and therapeutic perspectives
Raffaele Nardone, Luca Sebastianelli, Davide Ferrazzoli, Francesco Brigo, Piergiorgio Lochner, Leopold Saltuari, Eugen Trinka, Viviana Versace

Review Neurophysiol Clin. 2021 Oct 3;S0987-7053(21)00089-7. doi: 10.1016/j.neucli.2021.09.002. Online ahead of print.

Transcranial magnetic stimulation (TMS) can be a useful tool for the assessment of the brain functional reorganization in subjects with hemiplegic cerebral palsy (HCP). In this review, we performed a systematic search of all studies using TMS in order to explore the neuroplastic changes that occur in HCP patients. We aimed at investigating the usefulness of TMS to explore cortical excitability, plasticity and connectivity changes in HCP. Children with HCP due to unilateral lesions of the corticospinal system had ipsilateral motor evoked potentials (MEPs) similar to those recorded contralaterally. TMS studies demonstrated that occupational and constraint-induced movement therapy were associated with significant improvements in contralateral and ipsilateral corticomotor projection patterns. In addition, after intensive bimanual therapy, children with HCP showed increased activation and size of the motor areas controlling the affected hand. A TMS mapping study revealed a mediolateral location of the upper and lower extremity map motor cortical representations. Deficits in intracortical and interhemispheric inhibitory mechanisms were observed in HCP. Early hand function impairment correlated with the extension of brain damage, number of involved areas, and radiological signs of corticospinal tract (CST) degeneration. Clinical mirror movements (MMs) correlated with disability and CST organization in subjects with HCP and a positive relationship was found between MMs and MEPs strength. Therefore, TMS studies have shed light on important pathophysiological aspects of motor cortex and CST reorganization in HCP patients. Furthermore, repetitive TMS (rTMS) might have therapeutic effects on CST activities, functional connectivity and clinical status in children with HCP.

PMID: 34615605

22. Spatial Cognition in Children With Physical Disability; What Is the Impact of Restricted Independent Exploration?

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Front Hum Neurosci. 2021 Sep 16;15:669034. doi: 10.3389/fnhum.2021.669034. eCollection 2021.

Given the developmental inter-relationship between motor ability and spatial skills, we investigated the impact of physical disability (PD) on spatial cognition. Fifty-three children with special educational needs including PD were divided into those who were wheelchair users (n = 34) and those with independent locomotion ability (n = 19). This division additionally enabled us to determine the impact of limited independent physical exploration (i.e., required wheelchair use) on spatial competence. We compared the spatial performance of children in these two PD groups to that of typically developing (TD) children who spanned the range of non-verbal ability of the PD groups. Participants completed three spatial tasks; a mental rotation task, a spatial programming task and a desktop virtual reality (VR) navigation task. Levels of impairment of the PD groups were broadly commensurate with their overall level of non-verbal ability. The exception to this was the performance of the PD wheelchair group on the mental rotation task, which was below that expected for their level of non-verbal ability. Group differences in approach to the spatial programming task were evident in that both PD groups showed a different error pattern from the TD group. These findings suggested that for children with both learning difficulties and PD, the unique developmental impact on spatial ability of having physical disabilities, over and above the impact of any learning difficulties, is minimal.

PMID: 34602992

23. Pros and cons of botulinum toxin injection therapy in cerebral palsy: a qualitative study exploring caregivers' perspective

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Child Care Health Dev. 2021 Oct 8. doi: 10.1111/cch.12915. Online ahead of print.

Background: To describe and understand the experiences and beliefs of caregivers of children with cerebral palsy following botulinum toxin injection. Methods: A descriptive case study approach with focus group interviews was employed. A semi-structured questionnaire was conducted to collect data. Twenty-one caregivers of children (3-13 years old) with cerebral palsy were recruited with a maximum variation sampling strategy to gain insight through different perspectives. Qualitative analysis with verbatim transcripts was analyzed using a thematic approach. Findings: Four themes emerged from qualitative analyses: Acceptance of diagnosis, perceptions about treatment, caregivers' experiences with the health environment, and feelings and thoughts after the treatment. Conclusions: This study highlights caregivers' requests for information about the possible long-term effect of botulinum toxin, as well as information and support to provide the best rehabilitation program immediately after injection.

PMID: 34623695

24. Navigating the Pathway to Care in Adults With Cerebral Palsy

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Review Front Neurol. 2021 Sep 16;12:734139. doi: 10.3389/fneur.2021.734139. eCollection 2021.

As individuals with cerebral palsy (CP) age, they face unique challenges which complicate their ability to access and receive appropriate health care. These problems exist at the level of the health care system, the clinician, and the individual. At the system level, there is an inadequate number of professionals who are informed of and interested in the care of adults with CP. Pediatric clinicians prefer treating children, and adult caregivers are not knowledgeable about and may feel less competent about CP. Pediatric care does not translate well to the adult population, and information about best practices for adults is just starting to develop. Differences in the physiologic development of individuals with CP render well-established clinical protocols for risk screening of chronic diseases less effective. Moreover, lack of supportive resources decreases a caregiver's sense of self-efficacy in treating this population. The patient's ability to navigate these barriers is complicated by the high prevalence of comorbid cognitive impairment and mental health issues including anxiety, depression, and other psychiatric disorders; a bidirectional relationship between challenges in navigating care/needs and comorbid mental health conditions appears likely. Many patients have additional barriers related to social determinants of health, such as access to transportation, accessible health care facilities, and other personal and environmental factors that may impede health maintenance and wellness. Increasing and disseminating knowledge, harnessing the power of new technologies such as telemedicine, and addressing mental health issues are some of the methods that are available to help adults with CP navigate this road.

PMID: 34603186

25. Well-Being of Ambulatory Adults With Cerebral Palsy: Education, Employment, and Physical Function of a Cohort Who Received Specialized Pediatric Care

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Front Neurol. 2021 Sep 20;12:732906. doi: 10.3389/fneur.2021.732906. eCollection 2021.

Introduction: The transition from pediatric health care and school systems presents enormous challenges for young adults with cerebral palsy (CP). The lack of strong societal support during this seminal life event is well-documented and leads many adults with CP to struggle with independence, higher education, and employment. Despite the relatively high prevalence of CP, information about the experiences and function of adults with CP in our society continues to be limited. The purpose of this project was to describe well-being by assessing education, employment, physical function, walking activity, and utilization of health care in an ambulatory adult cohort with CP who received specialized pediatric care at our center. Method: In this Institutional Review Board-approved prospective study, we invited former patients from our tertiary care pediatric CP center to complete a set of patient-reported outcomes including (1) the Patient-Reported Outcomes Measurement Information System domains of physical function and pain interference, (2) the Satisfaction with Life Scale, and a project-specific demographic questionnaire about education, employment, income, independence, pain, and health care utilization. Participants also wore a pedometer for 8 days to monitor community walking activity. Chi-squared pairwise or t-tests were used as appropriate to compare survey responses and walking activity data between three groups: participants who self-reported, those who reported by proxy, and published normative data from age-matched typically developing adult (TDA) samples. Results: One hundred twenty-six adults with CP consented to participate; 85 self-reported [age 29.7 ± 4.3 years; Gross Motor Function Classification System: I (28%), II (47%), and III, (25%)] and 41 reported by proxy [age 29.7 ± 4.1 years; Gross Motor Function Classification System: I (10%), II (68%), and III (22%)]. For the group who self-reported, high school graduation rate (99%) was similar to TDA (92%; $p = 0.0173$) but bachelor's degree achievement rate (55%) was higher than TDA (37%; $p < 0.001$). Despite more advanced education, the unemployment rate in this group was higher than national levels at 33% and was associated with high utilization of Social Security Disability Insurance (33%). Within the self-reporting group, 13% required a caregiver. For the group who reported by proxy, educational levels (73% high school graduates, 0 bachelor's degree) were lower than the general population ($p < 0.001$) and unemployment was higher than the national level, at 64%. Unemployment in this group was associated with high utilization of Social Security Disability Insurance (85%). Within the proxy-reporting group, 71% required a caregiver. The full cohort demonstrated lower levels of physical function according to the Patient-Reported Outcomes Measurement Information System and less community walking activity compared with TDA references ($p < 0.001$). This cohort of adults with CP reported significantly higher frequency of chronic pain (48 vs. 12% for TDA; $p < 0.001$), but less pain interference with daily activities than TDA based on Patient-Reported Outcomes Measurement Information System results ($p < 0.001$). This cohort reported good to excellent overall health (93%) and high utilization of primary care (98%), but limited utilization of specialty care, specifically orthopedic care (21%) and physical therapy (15%). Discussion: This cohort of adults with CP had similar levels of education as the general population, but had relatively high rates of unemployment, caretaker need, and Social Security Disability Insurance utilization. Although chronic pain was frequent, the impact of pain on work and independent living did not exceed reports from a typically developing reference. Better targeted societal resources for adults with physical disabilities are urgently needed to allow equitable access to employment, promote opportunities for independence, and enable full participation in community life.

PMID: 34616355

26. Barriers and enablers to participating in regular screening programmes for women with cerebral palsy: A qualitative life course study

Sonali Shah, Julie Taylor, Caroline Bradbury-Jones

J Adv Nurs. 2021 Oct 6. doi: 10.1111/jan.15058. Online ahead of print.

Aims: To determine the barriers and enablers to regular, women-oriented screening programmes for women with cerebral palsy (CP); and to discuss the participants' suggestions for change. Design: Qualitative life course approach. Methods: Twenty-five life course interviews were conducted with women in 2020 who identified as having a diagnosis of CP. Interviews were conducted in person or using electronic platforms. Framework analysis was used to interpret the data. Findings: Access and utilization of regular screening programmes for women with CP across the life course are determined by multiple socioecological factors. Three themes are discussed focusing particularly on cervical and breast screening: 1. barriers, 2. enablers and 3. women's suggestions for change. Some women chose to opt out of sexual health checks for fear they would be too uncomfortable or the procedure would be too difficult. Practitioner attitudes towards disability in general, as well as the extent to which they understood the effects of CP for women, was highlighted as a barrier. Accessibility and adaptability of the environment also influenced women's uptake of screening. Conclusion: Women with CP face many challenges to their sexual and reproductive healthcare. These can deter them from participating in regular women-oriented screening programmes, which puts them at higher risk of preventable diseases. Understanding the lifelong effects of CP for women, and the interaction with their reproductive health could help to reduce unmet needs and increase participation in relevant screening across the life course. Impact: Knowledge of the challenges to regular screening programmes experienced by women with CP across the life course is crucial to provide appropriate preventative healthcare for women with CP across different stages of life. Elements of this knowledge could have benefits for the care of all disabled women.

PMID: 34617320

27. Abstracts for the American Academy for Cerebral Palsy and Developmental Medicine 6-9 October 2021

Dev Med Child Neurol. 2021 Oct;63 Suppl 3:5-108. doi: 10.1111/dmcn.15004.

PMID: 34601714

28. Commentary on "How Did the Lockdown Imposed Due to COVID-19 Affect Patients With Cerebral Palsy?"

Marissa Benigno Slate, Joanna Weir Tucker

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