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Interventions and Management

1. Comparative effects of kinect-based versus therapist-based constraint-induced movement therapy on motor control and daily motor function in children with unilateral cerebral palsy: a randomized control trial
Tsai-Yu Shih, Tien-Ni Wang, Jeng-Yi Shieh, Szu-Yu Lin, Shanq-Jang Ruan, Hsien-Hui Tang, Hao-Ling Chen

Randomized Controlled Trial J Neuroeng Rehabil. 2023 Jan 27;20(1):13. doi: 10.1186/s12984-023-01135-6.

Background: Constraint-induced movement therapy (CIMT) is a prominent neurorehabilitation approach for improving affected upper extremity motor function in children with unilateral cerebral palsy (UCP). However, the restraint of the less-affected upper extremity and intensive training protocol during CIMT may decrease children's motivation and increase the therapist's workload and family's burden. A kinect-based CIMT program, aiming to mitigate the concerns of CIMT, has been developed. The preliminary results demonstrated that this program was child-friendly and feasible for improving upper extremity motor function. However, whether the kinect-based CIMT can achieve better or at least comparable effects to that of traditional CIMT (i.e., therapist-based CIMT) should be further investigated. Therefore, this study aimed to compare the effects of kinect-based CIMT with that of therapist-based CIMT on upper extremity and trunk motor control and on daily motor function in children with UCP. Methods: Twenty-nine children with UCP were recruited and randomly allocated to kinect-based CIMT (n = 14) or therapist-based CIMT (n = 15). The intervention dosage was 2.25 h a day, 2 days a week for 8 weeks. Outcome measures, namely upper extremity and trunk motor control and daily motor function, were evaluated before and after 36-h interventions. Upper extremity and trunk motor control were assessed with unimanual reach-to-grasp kinematics, and daily motor function was evaluated with the Revised Pediatric Motor Activity Log. Between-group comparisons of effectiveness on all outcome measures were analyzed by analysis of covariance ($\alpha = 0.05$). Results: The two groups demonstrated similar improvements in upper extremity motor control and daily motor function. In addition, the kinect-based CIMT group demonstrated greater improvements in trunk motor control than the therapist-based CIMT group did ($F(1,28) > 4.862$, $p < 0.036$). Conclusion: Kinect-based CIMT has effects comparable to that of therapist-based CIMT on UE motor control and daily motor function. Moreover, kinect-based CIMT helps decrease trunk compensation during reaching in children with UCP. Therefore, kinect-based CIMT can be used as an alternative approach to therapist-based CIMT. Trial registration: ClinicalTrials.gov Identifier: NCT02808195. Registered on 2016/06/21, https://clinicaltrials.gov/ct2/show/NCT02808195 .

PMID: 36703170

2. Therapeutic Effects of Metaverse Rehabilitation for Cerebral Palsy: A Randomized Controlled Trial
Ilyoung Moon, Yeongsang An, Seunghwa Min, Chanhee Park

Randomized Controlled Trial Int J Environ Res Public Health. 2023 Jan 15;20(2):1578. doi: 10.3390/ijerph20021578.

Metaverse physical therapy (MPT), an adjuvant technology for the rehabilitation of children with cerebral palsy (CP), has

gained notoriety in the clinical field owing to its accessibility and because it provides motivation for rehabilitation. The aim is to compare the gross motor function and cardiopulmonary function, the activities of daily living, quality of life (QOL), and the perceived risk of coronavirus disease (COVID)-19 transmission between MPT and conventional physical therapy (CPT). A convenience sample of 26 children with CP (mean age, 11.23 ± 3.24 years, 14 females) were randomized into either the MPT or CPT group and received therapy three days/week for four weeks. Clinical outcomes included gross-motor-function measure 66 (GMFM-66), heart rate (HR), Borg-rating perceived exertion (BRPE), functional independence measure (FIM), pediatric QOL, and the risk of COVID-19 transmission. An analysis of variance showed that compared with CPT, MPT exerted positive effects on GMFM, HR, and BRPE. An independent t-test showed that compared with CPT, MPT exerted positive effects on the perceived transmission risk of COVID-19 but not on FIM and QOL. Our results provide promising therapeutic evidence that MPT improves gross motor function, cardiopulmonary function, and the risk of COVID-19 in children with CP.

PMID: 36674332

3. Skeletal muscle maximal mitochondrial activity in ambulatory children with cerebral palsy
No authors listed

Dev Med Child Neurol. 2023 Jan 26. doi: 10.1111/dmcn.15529. Online ahead of print.

PMID: 36700924

4. Associations between muscle morphology and spasticity in children with spastic cerebral palsy
Nicky Peeters, Britta Hanssen, Lynn Bar-On, Friedl De Groote, Nathalie De Beukelaer, Marjan Coremans, Christine Van den Broeck, Bernard Dan, Anja Van Campenhout, Kaat Desloovere

Eur J Paediatr Neurol. 2023 Jan 10;44:1-8. doi: 10.1016/j.ejpn.2023.01.007. Online ahead of print.

Introduction: Due to the heterogeneous clinical presentation of spastic cerebral palsy (SCP), which makes spasticity treatment challenging, more insight into the complex interaction between spasticity and altered muscle morphology is warranted. Aims: We studied associations between spasticity and muscle morphology and compared muscle morphology between commonly observed spasticity patterns (i.e. different muscle activation patterns during passive stretches). Methods: Spasticity and muscle morphology of the medial gastrocnemius (MG) and semitendinosus (ST) were defined in 74 children with SCP (median age 8 years 2 months, GMFCS I/II/III: 31/25/18, bilateral/unilateral: 46/27). Using an instrumented assessment, spasticity was quantified as the difference in muscle activation recorded during passive stretches at low and high velocities and was classified in mixed length-/velocity-dependent or pure velocity-dependent activation patterns. Three-dimensional freehand ultrasound was used to assess muscle morphology (volume and length) and echogenicity intensity (as a proxy for muscle quality). Spearman correlations and Mann-Whitney-U tests defined associations and group differences, respectively. Results: A moderate negative association ($r = -0.624$, $p < 0.001$) was found between spasticity and MG muscle volume, while other significant associations between spasticity and muscle morphology parameters were weak. Smaller normalized muscle volume (MG $p = 0.004$, ST $p=<0.001$) and reduced muscle belly length (ST $p = 0.015$) were found in muscles with mixed length-/velocity-dependent patterns compared to muscles with pure velocity-dependent patterns. Discussion: Higher spasticity levels were associated with smaller MG and ST volumes and shorter MG muscles. These muscle morphology alterations were more pronounced in muscles that activated during low-velocity stretches compared to muscles that only activated during high-velocity stretches.
PMID: 36706682

5. The Musculoskeletal System in Children with Cerebral Palsy
Christine Lührs

Neuropediatrics. 2023 Jan 23. doi: 10.1055/s-0042-1760636. Online ahead of print.

PMID: 36690014

6. Neurosurgical management of elevated tone in childhood: interventions, indications and uncertainties
Daniel E Lumsden

Review Arch Dis Child. 2023 Jan 23;archdischild-2020-320907. doi: 10.1136/archdischild-2020-320907. Online ahead of print.

Elevated tone (hypertonia) is a common problem in children with physical disabilities. Medications intended to reduce tone often have limited efficacy, with use further limited by a significant side effect profile. Consequently, there has been growing interest in the application of Neurosurgical Interventions for the Management of Posture and Tone (NIMPTs). Three main procedures are now commonly used: selective dorsal rhizotomy (SDR), intrathecal baclofen (ITB) and deep brain stimulation (DBS). This review compares these interventions, along with discussion on the potential role of lesioning surgery. These interventions variably target spasticity and dystonia, acting at different points in the distributed motor network. SDR, an intervention for reducing spasticity, is most widely used in carefully selected ambulant children with cerebral palsy. ITB is more commonly used for children with more severe disability, typically non-ambulant, and can improve both dystonia and spasticity. DBS is an intervention which may improve dystonia. In children with certain forms of genetic dystonia DBS may dramatically improve dystonia. For other causes of dystonia, and in particular dystonia due to acquired brain injury, improvements following surgery are more modest and variable. These three interventions vary in terms of their side-effect profile and reversibility. There are currently populations of children for who it is unclear which intervention should be considered (SDR vs ITB, or ITB vs DBS). Concerns have been raised as to the equity of access to NIMPTs for children across the UK, and whether the number of surgeries performed each year meets the clinical need.

PMID: 36690424

7. Analysis of trunk muscles activity during horseback riding machine exercise in children with spastic cerebral palsy: Erratum
No authors listed

Medicine (Baltimore). 2023 Jan 20;102(3):e32762. doi: 10.1097/MD.0000000000032762.

PMID: 36701741

8. Which gait training intervention can most effectively improve gait ability in patients with cerebral palsy? A systematic review and network meta-analysis
Guoping Qian, Xiaoye Cai, Kai Xu, Hao Tian, Qiao Meng, Zbigniew Ossowski, Jinghong Liang

Front Neurol. 2023 Jan 10;13:1005485. doi: 10.3389/fneur.2022.1005485. eCollection 2022.

Background: A vital objective to treat people with cerebral palsy (CP) is to increase gait velocity and improve gross motor function. This study aimed to evaluate the relative effectiveness of gait training interventions for persons with CP. Methods: Studies published up to October 26, 2022 were searched from four electronic databases [including Medline (via PubMed), Web of Science, Embase and Cochrane]. Studies with randomized controlled trials (RCTs), people with CP, comparisons of different gait training interventions and outcomes of gait velocity and gross motor function measures (GMFM) were included in this study. The quality of the literature was evaluated using the risk of bias tool in the Cochrane Handbook, the extracted data were analyzed through network meta-analysis (NMA) using Stata16.0 and RevMan5.4 software. Results: Twenty RCTs with a total of 516 individuals with CP were included in accordance with the criteria of this study. The results of the NMA analysis indicated that both external cues treadmill training (ECTT) [mean difference (MD) = 0.10, 95% confidence interval CI (0.04, 0.17), $P < 0.05$] and partial body weight supported treadmill training (BWSTT) [MD = 0.12, 95% CI (0.01, 0.23), $P < 0.05$] had better gait velocity than over ground gait training (OGT), BWSTT [MD = 0.09, 95%CI(0.01,0.18), $P < 0.05$] had a better gait velocity than robot-assisted gait training (RAGT), BWSTT [MD = 0.09, 95% CI (0.06, 0.13) $P < 0.05$] had a better gait velocity than treadmill training (TT), and BWSTT [MD = 0.14, 95% CI (0.07, 0.21), $P < 0.05$] had a better gait velocity than conventional physical therapy (CON). The SUCRA ranking indicated that BWSTT optimally improved the gait velocity, and the other followed an order of BWSTT (91.7%) > ECTT (80.9%) > RAGT (46.2%) > TT (44%) > OGT (21.6%) > CON (11.1%). In terms of GMFM, for dimension D (GMFM-D), there was no statistical difference between each comparison; for dimension E (GMFM-E), RAGT [MD = 10.45, 95% CI (2.51, 18.40), $P < 0.05$] was significantly more effective than CON. Both SUCRA ranking results showed that RAGT improved GMFM-D/E optimally, with rankings of RAGT (69.7%) > TT

(69.3%) > BWSTT (67.7%) > OGT (24%) > CON (20.3%), and RAGT (86.1%) > BWSTT (68.2%) > TT (58%) > CON (20.1%) > OGT (17.6%) respectively. Conclusion: This study suggested that BWSTT was optimal in increasing the gait velocity and RAGT was optimal in optimizing GMFM in persons with CP. Impacted by the limitations of the number and quality of studies, randomized controlled trials with larger sample sizes, multiple centers, and high quality should be conducted to validate the above conclusion. Further studies will be required to focus on the total duration of the intervention, duration and frequency of sessions, and intensity that are optimal for the promotion of gait ability in this population. Systematic review registration: https://doi.org/10.37766/inplasy2022.10.0108, identifier: INPLASY2022100108.

PMID: 36703638

9. American Society of Biomechanics Clinical Biomechanics Award 2021: Redistribution of muscle-tendon work in children with cerebral palsy who walk in crouch
Anahid Ebrahimi, Jack A Martin, Michael H Schwartz, Tom F Novacheck, Darryl G Thelen

Clin Biomech (Bristol, Avon). 2023 Jan 4;102:105871. doi: 10.1016/j.clinbiomech.2023.105871. Online ahead of print.

Background: Previous study showed the triceps surae exhibits spring-like behavior about the ankle during walking in children with cerebral palsy. Thus, the work generated by the triceps surae is diminished relative to typically developing children. This study investigated whether the quadriceps offset the lack of triceps surae work production in children with cerebral palsy who walk in crouch. Methods: Seven children with cerebral palsy (8-16 yrs) and 14 typically developing controls (8-17 yrs) walked overground at their preferred speed in a motion analysis laboratory. Shear wave tensiometers were used to track patellar and Achilles tendon loading throughout the gait cycle. Tendon force measures were coupled with muscle-tendon kinematic estimates to characterize the net work generated by the quadriceps and triceps surae about the knee and ankle, respectively. Findings: Children with cerebral palsy generated significantly less triceps surae work when compared to controls ($P < 0.001$). The reverse was true at the knee. Children with cerebral palsy generated positive net work from the quadriceps about the knee, which exceeded the net quadriceps work generated by controls ($P = 0.028$). Interpretation: There was a marked difference in functional behavior of the triceps surae and quadriceps in children with cerebral palsy who walk in crouch. In particular, the triceps surae of children with cerebral palsy exhibited spring-like behavior about the ankle while the quadriceps exhibited more motor-like behavior about the knee. This redistribution in work could partly be associated with the elevated energetic cost of walking in children with cerebral palsy and is relevant to consider when planning treatments to correct crouch gait.

PMID: 36701840

10. Determinants of gait dystonia severity in cerebral palsy
Bhooma R Aravamuthan, Toni S Pearson, Keisuke Ueda, Hanyang Miao, Gazelle Zerafati-Jahromi, Laura Gilbert, Cynthia Comella, Joel S Perlmutter

Dev Med Child Neurol. 2023 Jan 26. doi: 10.1111/dmcn.15524. Online ahead of print.

Aim: To determine the movement features governing expert assessment of gait dystonia severity in individuals with cerebral palsy (CP). Method: In this prospective cohort study, three movement disorder neurologists graded lower extremity dystonia severity in gait videos of individuals with CP using a 10-point Likert-like scale. Using conventional content analysis, we determined the features experts cited when grading dystonia severity. Then, using open-source pose estimation techniques, we determined gait variable analogs of these expert-cited features correlating with their assessments of dystonia severity. Results: Experts assessed videos from 116 participants (46 with dystonia aged 15 years [SD 3] and 70 without dystonia aged 15 years [SD 2], both groups ranging 10-20 years old and 50% male). Variable limb adduction was most commonly cited by experts when identifying dystonia, comprising 60% of expert statements. Effect on gait (regularity, stability, trajectory, speed) and dystonia amplitude were common features experts used to determine dystonia severity, comprising 19% and 13% of statements respectively. Gait variables assessing adduction variability and amplitude (inter-ankle distance variance and foot adduction amplitude) were significantly correlated with expert assessment of dystonia severity (multiple linear regression, $p < 0.001$). Interpretation: Adduction variability and amplitude are quantifiable gait features that correlate with expert-determined gait dystonia severity in individuals with CP. Consideration of these features could help optimize and standardize the clinical assessment of gait dystonia severity in individuals with CP.

PMID: 36701240

11. AFOs Improve Stride Length and Gait Velocity but Not Motor Function for Most with Mild Cerebral Palsy
Hank White, Brian Barney, Sam Augsburger, Eric Miller, Henry Iwinski

Sensors (Basel). 2023 Jan 4;23(2):569. doi: 10.3390/s23020569.

Ankle-foot orthoses (AFOs) are prescribed to children with cerebral palsy (CP) in hopes of improving their gait and gross motor activities. The purpose of this retrospective study was to examine if clinically significant changes in gross motor function occur with the use of AFOs in children and adolescents diagnosed with CP (Gross Motor Function Classification System levels I and II). Data from 124 clinical assessments were analyzed. Based on minimum clinically important difference (MCID), 77% of subjects demonstrated an increase in stride length, 45% of subjects demonstrated an increase in walking velocity, and 30% demonstrated a decrease in cadence. Additionally, 27% of the subjects demonstrated increase in gait deviation index (GDI). Deterioration in gait was evident by decreases in walking speed (5% of subjects), increases in cadence (11% of subjects), and 15% of subjects demonstrated decreases in gait deviation index. Twenty-two percent of subjects demonstrated no change in stride lengths and one participant demonstrated a decrease in stride length. However, AFOs improved Gross Motor Function Measure (GMFM) scores for a minority (10%) of children with mild CP (GMFCS level I and II), with 82-85% of subjects demonstrating no change in GMFM scores and 5-7% demonstrating decrease in GMFM scores.

PMID: 36679366

12. The Use of the 6MWT for Rehabilitation in Children with Cerebral Palsy: A Narrative Review
Domenico M Romeo, Ilaria Venezia, Margherita De Biase, Francesca Sini, Chiara Velli, Eugenio Mercuri, Claudia Brogna

Review J Pers Med. 2022 Dec 23;13(1):28. doi: 10.3390/jpm13010028.

Assessing and improving walking abilities is considered one of the most important functional goals of physical therapy in children with cerebral palsy. However, there is still a gap in knowledge regarding the efficacy of treatment targeting the walking capacity of children with CP, as well as their responsiveness to the treatment. The 6 min walk test (6MWT) is a reliable tool to measure this function in children with CP, although less has been known about its potential efficacy to assess changes in the walking abilities associated with interventions. The aim of the present narrative review is to increase the amount of knowledge regarding the use of the 6MWT as a reliable measure to evaluate the effect of interventions on walking capacity in children with CP.

PMID: 36675689

13. Foot drop after gastrocsoleus lengthening for equinus deformity in children with cerebral palsy
Nicholas Sclavos, Pam Thomason, Elyse Passmore, Kerr Graham, Erich Rutz

Gait Posture. 2023 Jan 13;100:254-260. doi: 10.1016/j.gaitpost.2023.01.007. Online ahead of print.

Background: Gastrocsoleus lengthening (GSL) is the most common surgical procedure to treat equinus deformity in ambulant children with cerebral palsy (CP). Foot drop, where the ankle remains in plantarflexion during swing phase, can persist in some children post-operatively. There is currently limited understanding of which children will demonstrate persistent foot drop after GSL. Research question: Which children develop persistent foot drop after GSL surgery for equinus? Methods: We conducted a retrospective cohort study on ambulant children with CP who had GSL surgery for fixed equinus deformity. The aims of the study were: to determine the frequency of persistent foot drop post-operatively and to compare outcome parameters from physical examination and three-dimensional gait analysis for children with hemiplegia or diplegia. Results: One hundred and ten children functioning at GMFCS Levels I/II/III of 28/75/7 met the inclusion criteria for this study. There were 71 boys and mean age was 9.1 years at time of GSL surgery. The overall frequency of persistent foot drop was 25%, with a higher frequency of persistent foot drop in children with hemiplegia (42%) than children with diplegia (19%). There were significant improvements in dorsiflexor strength and in selective motor control in children with diplegia but not in children with hemiplegia. Mean (SD) pre-operative mid-swing ankle dorsiflexion for children with hemiplegia was - 14.0° (9.9°) and improved post-operatively to - 1.6° (5.5°). For children with diplegia, the pre-operative mid-swing ankle dorsiflexion was - 12.1° (12.9°) and improved post-operatively to + 4.2° (6.9°). Significance: Foot drop is present following GSL surgery for

fixed equinus deformity in a significant number of children with hemiplegia and to a lesser extent in children with diplegia, which may reflect a difference in the central nervous system lesion between these groups. New management approaches are required for this important and unsolved problem.

PMID: 36682318

14. What are the optimum training parameters of progressive resistance exercise for changes in muscle function, activity and participation in people with cerebral palsy? A systematic review and meta-regression
Theofani A Bania, Nicholas F Taylor, Hsiu-Ching Chiu, Garyfalia Charitaki

Review Physiotherapy. 2022 Oct 19;119:1-16. doi: 10.1016/j.physio.2022.10.001. Online ahead of print.

Objectives: To explore the effect of progressive resistance exercise (PRE) on impairment, activity and participation of people with cerebral palsy (CP). Also, to determine which programme parameters provide the most beneficial effects. Data sources: Electronic databases searched from the earliest available time. Eligibility criteria: Randomised controlled trials (RCTs) implementing PRE as an intervention in people with cerebral palsy were included. Studies appraisal & synthesis methods: Methodological quality of trials was assessed with the PEDro scale. Meta-analysis and meta-regression were completed. Results: We included 20 reports of 16 RCTs (n = 504 participants). Results demonstrated low certainty evidence that PRE improved muscle strength (pooled standardised mean difference (SMD)= 0.59 (95%CI: 0.16-1.01; I^2=70%). This increase in muscle strength was maintained an average of 11 weeks after training stopped. There was also moderate certainty evidence that it is inconclusive whether PRE has a small effect on gross motor function (SMD= 0.14 (95%CI: -0.09 to 0.36; I^2=0%) or participation (SMD= 0.26 (95%CIs: -0.02 to 0.54; I^2=0%). When PRE was compared with other therapy there were no between -group differences. Meta-regression demonstrated no effect of PRE intensity or training volume (frequency x total duration) on muscle strength ($p > 0.5$). No serious adverse events were reported. There is lack of evidence of the effectiveness of PRE in adults and non-ambulatory people with CP. Conclusions: PRE is safe and increases muscle strength in young people with CP, which is maintained after training stops. The increase in muscle strength is unrelated to the PRE intensity or dose. CONTRIBUTION OF THE PAPER.

PMID: 36696699

15. Diet quality in adults with cerebral palsy: a modifiable risk factor for cardiovascular disease prevention
No authors listed

Dev Med Child Neurol. 2023 Jan 26. doi: 10.1111/dmcn.15530. Online ahead of print.

PMID: 36700513

16. Speech and Nonspeech Parameters in the Clinical Assessment of Dysarthria: A Dimensional Analysis
Wolfram Ziegler, Theresa Schölderle, Bettina Brendel, Verena Risch, Stefanie Felber, Katharina Ott, Georg Goldenberg, Mathias Vogel, Kai Bötzel, Lena Zettl, Stefan Lorenzl, Renée Lampe, Katrin Strecker, Matthis Synofzik, Tobias Lindig, Hermann Ackermann, Anja Staiger

Brain Sci. 2023 Jan 7;13(1):113. doi: 10.3390/brainsci13010113.

Nonspeech (or paraspeech) parameters are widely used in clinical assessment of speech impairment in persons with dysarthria (PWD). Virtually every standard clinical instrument used in dysarthria diagnostics includes nonspeech parameters, often in considerable numbers. While theoretical considerations have challenged the validity of these measures as markers of speech impairment, only a few studies have directly examined their relationship to speech parameters on a broader scale. This study was designed to investigate how nonspeech parameters commonly used in clinical dysarthria assessment relate to speech characteristics of dysarthria in individuals with movement disorders. Maximum syllable repetition rates, accuracies, and rates of isolated and repetitive nonspeech oral-facial movements and maximum phonation times were compared with auditory-perceptual and acoustic speech parameters. Overall, 23 diagnostic parameters were assessed in a sample of 130 patients with

movement disorders of six etiologies. Each variable was standardized for its distribution and for age and sex effects in 130 neurotypical speakers. Exploratory Graph Analysis (EGA) and Confirmatory Factor Analysis (CFA) were used to examine the factor structure underlying the diagnostic parameters. In the first analysis, we tested the hypothesis that nonspeech parameters combine with speech parameters within diagnostic dimensions representing domain-general motor control principles. In a second analysis, we tested the more specific hypotheses that diagnostic parameters split along effector (lip vs. tongue) or functional (speed vs. accuracy) rather than task boundaries. Our findings contradict the view that nonspeech parameters currently used in dysarthria diagnostics are congruent with diagnostic measures of speech characteristics in PWD.

PMID: 36672094

17. Training arithmetical skills when finger counting and working memory cannot be used: A single case study in a child with cerebral palsy
Maëlle Neveu, Marie Geurten, Laurence Rousselle

Appl Neuropsychol Child. 2023 Jan 25;1-13. doi: 10.1080/21622965.2023.2170798. Online ahead of print.

Children with cerebral palsy (CP) are at greater risk of mathematical learning disabilities due to associated motor and cognitive limitations. However, there is currently little evidence on how to support the development of arithmetic skills within such a specific profile. The aim of this single-case study was to assess the effectiveness of a neuropsychological rehabilitation of arithmetic skills in NG, a 9-year-old boy with CP who experienced math learning disability and cumulated motor and short-term memory impairments. This issue was explored combining multiple-baseline and changing-criterion designs. The intervention consisted of training NG to solve complex additions applying calculation procedures with a tailor-made computation tool. Based on NG's strengths, in accordance with evidence-based practice in psychology, the intervention was the result of a co-construction process involving N, his NG's parents and professionals (therapist and researchers). Results were analyzed by combining graph visual inspections with non-parametric statistics for single-case designs (NAP-scores). Analyses showed a specific improvement in NG's ability to solve complex additions, which maintained for up to 3 weeks after intervention. The training effect did not generalize to his ability to perform mental additions, and to process the symbolic magnitude.

PMID: 36696353

18. Risk factors for cerebral palsy and movement difficulties in 5-year-old children born extremely preterm
Adrien M Aubert, Raquel Costa, Samantha Johnson, Ulrika Ådén, Marina Cuttini, Corine Koopman-Esseboom, Jo Lebeer, Heili Varendi, Michael Zemlin, Véronique Pierrat, Jennifer Zeitlin; SHIPS Research group

Pediatr Res . 2023 Jan 24. doi: 10.1038/s41390-022-02437-6. Online ahead of print.

Background: Motor impairment is common after extremely preterm (EPT, <28 weeks' gestational age (GA)) birth, with cerebral palsy (CP) affecting about 10% of children and non-CP movement difficulties (MD) up to 50%. This study investigated the sociodemographic, perinatal and neonatal risk factors for CP and non-CP MD. Methods: Data come from a European population-based cohort of children born EPT in 2011-2012 in 11 countries. We used multinomial logistic regression to assess risk factors for CP and non-CP MD (Movement Assessment Battery for Children - 2nd edition ≤5th percentile) compared to no MD (>15th percentile) among 5-year-old children. Results: Compared to children without MD (n = 366), young maternal age, male sex and bronchopulmonary dysplasia were similarly associated with CP (n = 100) and non-CP MD (n = 224) with relative risk ratios (RRR) ranging from 2.3 to 3.6. CP was strongly related to severe brain lesions (RRR >10), other neonatal morbidities, congenital anomalies and low Apgar score (RRR: 2.4-3.3), while non-CP MD was associated with primiparity, maternal education, small for GA (RRR: 1.6-2.6) and severe brain lesions, but at a much lower order of magnitude. Conclusion: CP and non-CP MD have different risk factor profiles, with fewer clinical but more sociodemographic risk factors for non-CP MD. Impact: Young maternal age, male sex and bronchopulmonary dysplasia similarly increased risks of both cerebral palsy and non-cerebral palsy movement difficulties. Cerebral palsy was strongly related to clinical risk factors including severe brain lesions and other neonatal morbidities, while non-cerebral palsy movement difficulties were more associated with sociodemographic risk factors. These results on the similarities and differences in risk profiles of children with cerebral palsy and non-cerebral palsy movement difficulties raise questions for etiological research and provide a basis for improving the identification of children who may benefit from follow-up and early intervention.

PMID: 36694025

19. The Sexual and Reproductive Health of Adolescents with Cerebral Palsy in Rural Bangladesh: A Qualitative Analysis
Rosalie Power, Eamin Heanoy, Manik Chandra Das, Tasneem Karim, Mohammad Muhit, Nadia Badawi, Gulam Khandaker

Arch Sex Behav. 2023 Jan 24. doi: 10.1007/s10508-023-02535-4. Online ahead of print.

Adolescents with disability in the Global South have unique sexual and reproductive health (SHR) experiences and needs; however, they are rarely included in SRH discourse. This qualitative study, conducted in rural Bangladesh, used semi-structured interviews to understand how adolescents with cerebral palsy (CP) experience their SRH. Participants were recruited from the Bangladesh Cerebral Palsy Register and included 24 adolescents with CP (n = 12 female; n = 12 male) and 76 parents (n = 56 mothers, n = 17 fathers, n = 3 other relatives). Data were analyzed using reflexive thematic analysis. Findings highlighted heterogeneity among adolescents with CP including differences for adolescent men versus women. For some adolescent men with CP, sexual maturity was viewed as bringing new opportunities, whereas for other men, adolescence affirmed exclusions and some transgressed sociocultural norms as they struggled to navigate their pubescent body alongside new privacy requirements. For adolescent women with CP, sexual maturity was associated with new domestic responsibilities, silence and secrecy regarding menstruation, and increased vulnerability to sexual violence and abuse. Adolescent men and women with CP spoke about marriage as something "everybody wants," however, was deemed "impossible" for those with more impairment-related support needs. Both adolescent men and women with CP lacked access to SRH information and support. Mothers positioned providing care to their adolescent child with CP after puberty as "shameful." Our findings suggest that disability, health, and education services in rural Bangladesh need to adopt a life-course approach that incorporates the SRH of adolescents with CP. We recommend the provision of SRH education that addresses the physical, cognitive, and social needs of adolescents with CP.

PMID: 36692630

20. Editorial: Adults with childhood onset disabilities: A lifespan approach
Elisabet Rodby-Bousquet, Mark D Peterson

Editorial Front Neurol. 2023 Jan 4;13:1115869. doi: 10.3389/fneur.2022.1115869. eCollection 2022.

PMID: 36686513

21. People with cerebral palsy demand a major shift in research
The Lancet Neurology

Editorial Lancet Neurol. 2023 Feb;22(2):101. doi: 10.1016/S1474-4422(23)00006-6.

PMID: 36681435

22. Proportion of Infant Neurodevelopment Trials Reporting a Null Finding: A Systematic Review
Megan Finch-Edmondson, Madison C B Paton, Ingrid Honan, Claire Galea, Annabel Webb, Iona Novak, Nadia Badawi, Amit Trivedi

Pediatrics. 2023 Feb 1;151(2):e2022057860. doi: 10.1542/peds.2022-057860.

Context: Discovering new interventions to improve neurodevelopmental outcomes is a priority; however, clinical trials are challenging and methodological issues may impact the interpretation of intervention efficacy. Objectives: Characterize the

proportion of infant neurodevelopment trials reporting a null finding and identify features that may contribute to a null result. Data sources: The Cochrane library, Medline, Embase, and CINAHL databases. Study selection: Randomized controlled trials recruiting infants aged <6 months comparing any "infant-directed" intervention against standard care, placebo, or another intervention. Neurodevelopment assessed as the primary outcome between 12 months and 10 years of age using a defined list of tools. Data extraction: Two reviewers independently extracted data and assessed quality of included studies. Results: Of n = 1283 records screened, 21 studies (from 20 reports) were included. Of 18 superiority studies, >70% reported a null finding. Features were identified that may have contributed to the high proportion of null findings, including selection and timing of the primary outcome measure, anticipated effect size, sample size and power, and statistical analysis methodology and rigor. Limitations: Publication bias against null studies means the proportion of null findings is likely underestimated. Studies assessing neurodevelopment as a secondary or within a composite outcome were excluded. Conclusions: This review identified a high proportion of infant neurodevelopmental trials that produced a null finding and detected several methodological and design considerations which may have contributed. We make several recommendations for future trials, including more sophisticated approaches to trial design, outcome assessment, and analysis.

PMID: 36695068

23. Fetal Ultrasound and Magnetic Resonance Imaging Abnormalities in Congenital Cytomegalovirus Infection Associated with and without Fetal Growth Restriction
Kenji Tanimura, Akiko Uchida, Mizuki Uenaka, Hitomi Imafuku, Shinya Tairaku, Hiromi Hashimura, Yoshiko Ueno, Takumi Kido, Kazumichi Fujioka

Diagnostics (Basel). 2023 Jan 13;13(2):306. doi: 10.3390/diagnostics13020306.

Congenital cytomegalovirus infection (cCMV) can cause fetal growth restriction (FGR) and severe sequelae in affected infants. Clinicians generally suspect cCMV based on multiple ultrasound (US) findings associated with cCMV. However, no studies have assessed the diagnostic accuracy of fetal US for cCMV-associated abnormalities in FGR. Eight FGR and 10 non-FGR fetuses prenatally diagnosed with cCMV were examined by undergoing periodic detailed US examinations, as well as postnatal physical and imaging examinations. The diagnostic accuracy of prenatal US for cCMV-associated abnormalities was compared between FGR and non-FGR fetuses with cCMV. The diagnostic sensitivity rates of fetal US for cCMV-related abnormalities in FGR vs. non-FGR fetuses were as follows: ventriculomegaly, 66.7% vs. 88.9%; intracranial calcification, 20.0% vs. 20.0%; cysts and pseudocysts in the brain, 0% vs. 0%; ascites, 100.0% vs. 100.0%; hepatomegaly, 40.0% vs. 100.0%; splenomegaly, 0% vs. 0%. The diagnostic sensitivity of fetal US for hepatomegaly and ventriculomegaly in FGR fetuses with cCMV was lower than that in non-FGR fetuses with cCMV. The prevalence of severe long-term sequelae (e.g., bilateral hearing impairment, epilepsy, cerebral palsy, and severe developmental delay) in the CMV-infected fetuses with FGR was higher, albeit non-significantly. Clinicians should keep in mind the possibility of overlooking the symptoms of cCMV in assessing fetuses with FGR.

PMID: 36673117

24. "A Different Ride": A Qualitative Interview Study of Parents' Experience with Early Diagnosis and Goals, Activity, Motor Enrichment (GAME) Intervention for Infants with Cerebral Palsy
Catherine Morgan, Nadia Badawi, Iona Novak

J Clin Med. 2023 Jan 11;12(2):583. doi: 10.3390/jcm12020583.

Cerebral palsy is the most common physical disability of childhood, and early diagnosis followed by best practice early intervention is important for optimizing child and family outcomes. We investigated parents' views of an early diagnosis of cerebral palsy (CP), followed by Goals, Activity, Motor Enrichment (GAME) intervention. Semi-structured interviews were conducted within a pilot randomised clinical trial. Transcriptions were analyzed using grounded theory. Participants were nine mothers whose infants had received GAME intervention because they were identified as being at high risk for cerebral palsy early in infancy. The parenting experience was described as a "different ride". The diagnosis was devastating with many time-consuming challenges, but acceptance ensued. Parents wanted an early diagnosis, prognosis, and early intervention, despite the anxiety and workload, because it meant they could help. Parents perceived that GAME was beneficial because they were taught how to help; it was goal-based and home-based. They believed the collaboration and communication skills of the therapist shaped success. Future research should focus on a broader range of participants to understand parent's experiences with key aspects of early intervention more fully.

PMID: 36675512

25. Diagnostic accuracy of the Hammersmith Neonatal Neurological Examination in predicting motor outcome at 12 months for infants born very preterm
Grace T Howard, Emmah Baque, Paul B Colditz, Mark D Chatfield, Robert S Ware, Roslyn N Boyd, Joanne M George

Dev Med Child Neurol. 2023 Jan 22. doi: 10.1111/dmcn.15512. Online ahead of print.

Aim: To evaluate the predictive validity of the Hammersmith Neonatal Neurological Examination (HNNE) performed early (at 32 weeks postmenstrual age) and at term-equivalent age (TEA) for 12-month motor outcomes in infants born very preterm. Method: This was a diagnostic study using data from a prospective birth cohort. A total of 104 infants born preterm at less than 31 weeks gestational age (males n = 61; mean = 28 weeks 1 day [SD 1 week 6 days], range 23 weeks 1 day-30 weeks 6 days) underwent HNNE early and at TEA, which were scored by comparison with term data. Motor outcomes at 12 months corrected age were determined using the Bayley Scales of Infant and Toddler Development, Third Edition (scores ≤85). Cut-off points were determined using receiver operating characteristic curves. Results: Sixteen (15%) infants born preterm had motor impairment at 12 months corrected age. The HNNE total score cut-off points with the best combination of sensitivity and specificity at early and TEA assessments were 15.2 or lower (sensitivity 77%, 95% confidence interval [CI] = 46%-95%; specificity 74%, 95% CI = 63%-83%) and 23.5 or lower (sensitivity 67%, 95% CI = 38%-88%; specificity 66%, 95% CI = 54%-76%) respectively. The most predictive subscale at the early assessment was reflexes (sensitivity 86%, 95% CI = 57%-98%; specificity 62%, 95% CI = 51%-72%; cut-off point ≤3); at TEA, it was spontaneous movements (sensitivity 73%, 95% CI = 45%-92%; specificity 60%, 95% CI = 48%-70%; cut-off point ≤2). Interpretation: The HNNE provides moderate predictive accuracy for motor outcome at 12 months corrected age in infants born very preterm. Although modest at both time points, early assessment had stronger predictive ability for motor outcomes than TEA when scored using term data, highlighting the value of performing the HNNE earlier in the neonatal period. Performing HNNE earlier may assist risk stratification when planning follow-up services.

PMID: 36683126

26. Automated oxygen control for very preterm infants and neurodevelopmental outcome at 2 years-a retrospective cohort study
Hylke H Salverda, N Nathalie J Oldenburger, Monique Rijken, R Ratna N G B Tan, Arjan B Te Pas, Jeanine M M van Klink

Eur J Pediatr. 2023 Jan 25. doi: 10.1007/s00431-023-04809-4. Online ahead of print.

Faster resolution of hypoxaemic or hyperoxaemic events in preterm infants may reduce long-term neurodevelopmental impairment. Automatic titration of inspiratory oxygen increases time within the oxygen saturation target range and may provide a more prompt response to hypoxic and hyperoxic events. We assessed routinely performed follow-up at 2 years of age after the implementation of automated oxygen control (AOC) as standard care and compared this with a historical cohort. Neurodevelopmental outcomes at 2 years of age were compared for infants born at 24-29 weeks gestational age before (2012-2015) and after (2015-2018) the implementation of AOC as standard of care. The primary outcome was a composite outcome of either mortality or severe neurodevelopmental impairment (NDI), and other outcomes assessed were mild-moderate NDI, Bayley-III composite scores, cerebral palsy GMFCS, and CBCL problem behaviour scores. A total of 289 infants were included in the pre-AOC epoch and 292 in the post-AOC epoch. Baseline characteristics were not significantly different. Fifty-one infants were lost to follow-up (pre-AOC 6.9% (20/289), post-implementation 10.6% (31/292). The composite outcome of mortality or severe NDI was observed in 17.9% pre-AOC (41/229) vs. 24.0% (47/196) post-AOC (p = 0.12). No significant differences were found for the secondary outcomes such as mild-moderate NDI, Bayley-III composite scores, cerebral palsy GMFCS, and problem behaviour scores, with the exception of parent-reported readmissions until the moment of follow-up which was less frequent post-AOC than pre-AOC. Conclusion: In this cohort study, the implementation of automated oxygen control in our NICU as standard of care for preterm infants led to no statistically significant difference in neurodevelopmental outcome at 2 years of age. What is known: • Neurodevelopmental outcome is linked to hypoxemia, hyperoxaemia and choice of SpO2 target range. • Automated titration of inspired oxygen may provide a faster resolution of hypoxaemic and hyperoxaemic events. What is new: • This cohort study did not find a significant difference in neurodevelopmental outcome at two years of age after implementing automated oxygen control as standard of care.

PMID: 36693993

27. The density of bone marrow mononuclear cells and CD34+ cells in patients with three neurologic conditions
Kien Trung Nguyen, Nhung Thi My Hoang, Hoang-Phuong Nguyen, Liem Nguyen Thanh

BMC Neurol. 2023 Jan 23;23(1):37. doi: 10.1186/s12883-023-03071-3.

Background: This study aimed to identify the density of mononuclear cells (MNCs) and CD34+ cells in the bone marrow of patients with three neurologic conditions. Methods: The study included 88 patients with three neurologic conditions: 40 with cerebral palsy (CP) due to oxygen deprivation (OD), 23 with CP related to neonatal icterus (NI), and 25 with neurological sequelae after traumatic brain injury. Bone marrow aspiration was conducted from the patients' bilateral anterior iliac crest under general anesthesia in an operating theater. MNCs were isolated by Ficoll gradient centrifugation and then infused intrathecally. Results: There was a significant difference in the average MNC per ml and percentage of CD34+ cells by the type of disease, age group, and infusion time (p value < 0.05). The multivariable regression model showed the percentage of CD34+ association with the outcome (gross motor function 88 items- GMFM-88) in patients with CP. Conclusions: The density of MNCs was 5.22 million cells per mL and 5.03% CD34+ cells in patients with three neurologic conditions. The highest density of MNCs in each ml of bone marrow was found in patients with CP due to OD, whereas the percentage of CD34+ cells was the highest among patients with CP related to NI.

PMID: 36690963

28. A novel variant in BCL11B in an individual with neurodevelopmental delay: A case report
Yonglin Yu, Xiaoyi Jia, Hongwei Yin, Hongfang Jiang, Yu Du, Fan Yang, Zuozhen Yang, Haifeng Li

Mol Genet Genomic Med. 2023 Jan 23;e2132. doi: 10.1002/mgg3.2132. Online ahead of print.

Background: B-Cell CLL/Lymphoma 11B (BCL11B) is a C2 H2 zinc finger transcription factor that has broad biological functions and is essential for the development of the immune system, neural system, cardiovascular system, dermis, and dentition. Variants of BCL11B have been found in patients with neurodevelopmental disorders and immunodeficiency. Materials and methods: Whole-exome sequencing (WES) and clinical examinations were performed to identify the etiology of our patient. A variant in the BCL11B gene, NM_138576.4: c.1206delG (p.Phe403Serfs*2) was found and led to frameshift truncation. Results: We reported a male patient with developmental delay and cerebral palsy who carried the BCL11B variant. The detailed clinical features, such as brain structure and immune detection, were described and reviewed in comparison to previous patients. Conclusions: The BCL11B-related neurodevelopmental disorders are rare, and only 17 variants in 25 patients have been found to date. Our report expands the variants spectrum of BCL11B and increases the case of neurodevelopmental abnormalities.

PMID: 36683525

29. Case report: LAMC3- associated cortical malformations: Case report of a novel stop-gain variant and literature review
Giovanni Falcicchio, Antonella Riva, Angela La Neve, Michele Iacomino, Patrizia Lastella, Patrizia Suppressa, Vittorio Sciruicchio, Maria Trojano, Pasquale Striano

Case Reports Front Genet. 2023 Jan 6;13:990350. doi: 10.3389/fgene.2022.990350. eCollection 2022.

Background: Malformations of cortical development (MCDs) can lead to peculiar neuroradiological patterns and clinical presentations (i.e., seizures, cerebral palsy, and intellectual disability) according to the specific genetic pathway of the brain development involved; and yet a certain degree of phenotypic heterogeneity exists even when the same gene is affected. Here we report a man with an malformations of cortical development extending beyond occipital lobes associated with a novel stop-gain variant in LAMC3. Case presentation: The patient is a 28-year-old man suffering from drug-resistant epilepsy and moderate intellectual disability. He underwent a brain magnetic resonance imaging showing polymicrogyria involving occipital

and temporal lobes bilaterally. After performing exome sequencing, a novel stop-gain variant in LAMC3 (c.3871C>T; p. Arg1291*) was identified. According to the cortical alteration of the temporal regions, temporal seizures were detected; instead, the patient did not report occipital seizures. Different pharmacological and non-pharmacological interventions (i.e., vagus nerve stimulation) were unsuccessful, even though a partial seizure reduction was obtained after cenobamate administration. Conclusion: Our case report confirms that variants of a gene known to be related to specific clinical and neuroradiological pictures can unexpectedly lead to new phenotypes involving different areas of the brain.

PMID: 36685914

30. Multisystem compensations and consequences in spastic quadriplegic cerebral palsy children
Luh Karunia Wahyuni

Review Front Neurol. 2023 Jan 9;13:1076316. doi: 10.3389/fneur.2022.1076316. eCollection 2022.

Spastic quadriplegic cerebral palsy (CP) is a permanent neuromuscular disorder causing limitation on all four limbs following a lesion on the developing brain. Most children with spastic quadriplegic CP are identified to be Gross Motor Function Classification System (GMFCS) level V, thus they have more comorbidities compared to other types at lower levels. Spastic quadriplegic CP is characterized by weak and inactive postural muscles of the neck and trunk, hence, they will undergo a total

body extension as a compensatory mechanism leading to an atypical movement pattern, that give rise to multisystem consequences that reduce their quality of life. The relationship between atypical movement patterns, compensatory strategies, and multisystem consequences have not yet been explored. In fact, these multisystem consequences aggravate their condition and make movement much more atypical, forming a vicious cycle. This review aimed to provide a summary and highlight the mechanism of atypical movement pattern, multisystem compensations, and consequences in spastic quadriplegic CP children. It is true that central nervous system (CNS) lesion in CP is non-progressive, however the multisystem consequences may impair overall function over time. An understanding of how compensatory strategy and multisystem consequences in spastic quadriplegic CP offers the opportunity to intervene as early as possible to improve their quality of life.

PMID: 36698899

31. Factors Affecting the Use of Pain-Coping Strategies in Individuals with Cerebral Palsy and Individuals with Typical Development
Inmaculada Riquelme, Pedro Montoya

Children (Basel). 2023 Jan 9;10(1):131. doi: 10.3390/children10010131.

Many individuals with cerebral palsy (CP) suffer from pain and must develop pain-coping strategies, although the factors determining them are unknown. This observational study aims at exploring the association between different pain-coping strategies and factors such as age, sex, pain, health status, sleep or motor and cognitive function in individuals with cerebral palsy (CP) and typically developing peers (TD). Main caregivers of 94 individuals with CP (age range = 6-69 years, mean age = 17.78 (10.05)) and the closest relative of 145 individuals with TD (age range = 6-51 years, mean age = 19.13 (12.87)) completed questionnaires on the previous topics (Parent Report of the PEDsQL Pediatric Coping Inventory, the Health Utility Index HUI-3, Epworth Sleepiness Score and the Pittsburgh Sleep Quality Index). Pain presence, duration, intensity, location and ratings of current and worst pain in the last week in an 11-point numerical rating scale were assessed in an interview. Global health was the best predictor the of use of any type of pain-coping strategy, including cognitive self-instruction, problem-solving, distraction, seeking social support and catastrophizing, in both individuals with CP and individuals with TD. However, different health attributes predicted their use in each population. Emotional health was the best predictor in individuals with CP, whereas cognition and pain were the best predictors in individuals with TD. Speech ability was a predictor in both groups. In conclusion, the assessment of health attributes such as emotional health and speech may help design specific interventions for enhancing self-efficacy and adaptive pain coping skills.

PMID: 36670681