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Interventions and Management

1. Parents' perceptions of functional electrical stimulation as an upper limb intervention for young children with hemiparesis: qualitative interviews with mothers

Emma Swaffield, Jaynie F Yang, Patricia Manns, Katherine Chan, Kristin E Musselman

BMC Pediatr. 2022 Jun 15;22(1):346. doi: 10.1186/s12887-022-03403-1.

Background/objective: To explore parents' perceptions of an upper extremity (UE) intervention using functional electrical stimulation (FES) for young children with hemiparesis. Methods: Parents of children aged 3-6 years with a history of perinatal stroke, impaired UE function, and participation in a 12-week FES intervention delivered at a hospital were included in this exploratory qualitative study. Nine mothers participated in a semi-structured interview < 1 week after their child completed the FES intervention (MyndMove®, MyndTec Inc.) targeting the hemiparetic UE. Open-ended questions queried parents' goals, perceived benefits, and challenges of the FES intervention. Interviews were audio recorded and transcribed verbatim. Qualitative conventional content analysis was used to analyze the transcripts. Results: Five themes were identified. 1) Parents' expectations for the FES intervention. Mothers described setting functional, exploratory, and realistic goals, yet feeling initial apprehension towards FES. 2) Perceived improvement. Physical, functional, and psychological improvements were observed with FES; however, there was still room for improvement. 3) Factors influencing the FES intervention. Program structure, therapist factors, and child factors influenced perceived success. 4) Lack of access to intensive therapy. Mothers noted that FES is not provided in mainstream therapy; however, they wanted access to FES outside of the study. They also highlighted socioeconomic challenges to accessing FES. 5) Strategies to facilitate participation. The mothers provided suggestions for program structure and delivery, and session delivery. Conclusions: Mothers perceived the FES intervention to have physical, functional and psychological benefits for their children. Interest in continuing with FES highlights a need to improve access to this therapy for young children.

PMID: [35705938](#)

2. More than my hands

Ilya Smolensky

Science. 2022 Jun 17;376(6599):1350. doi: 10.1126/science.add4296. Epub 2022 Jun 16.

No abstract available

PMID: [35709279](#)

3. Definitive fusion for scoliosis in late juvenile cerebral palsy patients is durable at 5 years postoperatively

Roland Howard, Paul D Sponseller, Suken A Shah, Firoz Miyanji, Amer F Samdani, Peter O Newton, Harms Study Group Investigators; Burt Yazsaz

Spine Deform. 2022 Jun 17. doi: 10.1007/s43390-022-00530-8. Online ahead of print.

Purpose: Given the challenges associated with managing progressive scoliosis in patients with cerebral palsy (CP), the purpose of this study was to evaluate deformity correction and HRQOL 5 years post-spinal fusion in CP patients who were skeletally immature at the time of surgical correction. **Methods:** CP patients who underwent definitive fusion before age 11 with minimum 5-years follow-up from a prospective, multicenter registry were included. Preoperative, initial postoperative, and 5-year radiographic data were collected. Preoperative and 5-years demographic, surgical data, complications, and CPCHILD outcome scores were analyzed. Repeated measures ANOVA with Bonferroni adjustment were used to analyze radiographic measures. Paired t test was utilized to compare outcomes. Significance was set at $p = 0.05$. **Results:** Twenty patients met inclusion-17 females, 3 males. The mean age was 9 (range 8-10) years. Eight-five percent had spastic CP with GMFCS Level V. Eighteen patients underwent posterior fusion; distal fixation was to the ilium in 80% and to L4-S1 in 20%. Significant correction of the primary curve ($p \leq 0.001$) and pelvic obliquity ($p \leq 0.001$) were obtained. From initial postoperative to 5-years follow-up there were no significant changes in major curve magnitude ($p = 0.638$), thoracic kyphosis ($p = 0.09$) or pelvic obliquity ($p = 0.28$). CPCHILD personal care, mobility, comfort, and total scores improved from preoperative to 5-years ($p < 0.05$). One patient needed a reoperation. **Conclusion:** Surgical decision making for scoliosis in patients with CP can be difficult given the desire to maximize growth while minimizing adverse events. Performing a definitive fusion is a viable option that achieves good correction which remains stable 5 years postoperatively.

PMID: [35713874](#)

4. Reliability and validity of the Turkish version of Fullerton Advanced Balance Scale in cerebral palsy

Sinem Erturan, Pelin Atalan, Yasin Ali Çimen, Derya Gökmen, Özlem Akkoyun Sert, Kamil Yıldız, Bülent Elbasan

Gait Posture. 2022 Jun 16;96:295-300. doi: 10.1016/j.gaitpost.2022.06.007. Online ahead of print.

Background: The Fullerton Advanced Balance Scale (FAB) is a multi-item balance assessment test designed to measure balance in relatively higher functioning individuals. The aim of this study was to examine the reliability and validity of the Turkish version of the FAB (FAB-T) in children with cerebral palsy (CP). **Research question:** Is the Turkish version of the Fullerton Advance Balance Scale valid and reliable in determining balance problems in children with cerebral palsy and determining the underlying cause of this condition? **Methods:** Forty-six children with CP participated in this study. Rasch analysis was used to investigate item adherence. Internal consistency of the FAB-T was established using Cronbach's alpha coefficient. Test-retest reliability was also evaluated. In addition, to assess concurrent validity, FAB-T scores were compared with the Pediatric Balance Scale (PBS) using the Spearman correlation coefficient. **Results:** The FAB-T showed satisfactory internal consistency (Cronbach's alpha value=0.94) and excellent test-retest reliability (ICC=0.99). The FAB and the PBS exhibited concurrent positive validity ($r = 0.913$; $p < 0.001$). All items of the FAB-T were found to fit the Rasch Model (Chi-square 16.01(df=20), $p = 0.716$). **Significance:** The FAB-T is a reliable and valid tool that can be used to measure balance skills and to identify the source of the problem in children with CP.

PMID: [35749866](#)

5. [Acetabular plasty assisted by 3D printing for the treatment of dislocation of hip joint in children with cerebral palsy] [Article in Chinese]

Ru-Fa Wang, Peng Xu, Peng-Fei Zheng, Yue Lou, Xiao-Guang Zhou

Zhongguo Gu Shang. 2022 Jun 25;35(6):572-7. doi: 10.12200/j.issn.1003-0034.2022.06.013.

Objective: To identify types of acetabular dysplasia, select the most suitable acetabular plasty, and analyze indications and efficacy of three types of acetabular plasty in treating dislocation of hip joint in children with cerebral palsy by 3D printing technology. **Methods:** From July 2019 to December 2019, 7 children with cerebral palsy with hip dislocation were treated with acetabular plasty assisted by 3D printing technology, including 3 males and 4 females, aged from 3 to 8 years old; 3 patients

on the left side, 2 patients on the right side, and 2 patients on both sides. Subluxation of hip joint occurred in 2 patients and dislocation of hip joint occurred in 5 patients. Preoperative full-length CT scan of pelvis and femur was performed in all children. The types of acetabular dysplasia were determined by 3D printing reconstruction technology, and the results were presented as follows: 2 anterior hips, 2 anterior outer hips, 1 outer upper hip, 2 posterior hips, 1 posterior outer hip, and 1 hip without dysplasia (with no acetabular plasty). Pemberton, Dega and San Diego surgery simulations were performed on the 8 hips respectively to find the most suitable and the suitable operations were then conducted. Migration percentage (MP), acetabular index (AI) and cenal-edge angle (CEA), Shenton line, and gross motor function classification system (GMFCS) between preoperative and last follow-up were compared and complications were recorded. Results: The wound healed well after operation and no complication occurred. Seven patients were followed up for 18 to 24 months. The 8 hips were underwent soft tissue release for the first stage+proximal femoral varus and rotation reduction osteotomy+hip reduction+acetabular plasty; 1 hip was underwent soft tissue release for the first stage+proximal femoral varus removal and rotation reduction osteotomy +hip reduction. MP decreased from 58% to 100% preoperatively to 0 to 17.9% at the latest follow-up. AI decreased from 25.0° to 47.6° preoperatively to 11.1° to 25.3° at the latest follow-up. CEA increased from 0° preoperatively to 21.1° to 48.5° at the latest follow-up. Shenton's lines changed from interrupted ones to continuous ones. The GMFCS grade of 5 cases decreased by 1 grade, and 2 cases showed no change. Conclusion: There is diversity for the hip dislocation of hip in children with cerebral palsy of acetabular dysplasia present type. Accurate judgments could be made with the help of 3D printing reconstruction techniques. There are differences between scopes of applications for three kinds of acetabulum keratoplasty. 3D printing technology could be helpful to choose the most suitable operation method and estimate the treatment effect. Thus the individualized and accurate treatment for hip dislocation in children with cerebral palsy can be gained with 3D printing technology.

PMID: [35730229](#)

6. Foot Drop, Hindfoot Varus, and Tibialis Posterior Tendon Transfer in Cerebral Palsy

Lydia J McKeithan, Amanda T Whitaker

Review Orthop Clin North Am. 2022 Jul;53(3):311-317. doi: 10.1016/j.ocl.2022.03.005. Epub 2022 May 27.

The transfer of the tibialis posterior tendon has been used to correct hindfoot varus and dorsiflexion weakness in cerebral palsy. It is expendable, has a favorable direction for dorsiflexion and eversion posterior to the tibia, and is the source of hindfoot varus in most cases. However, the foot and ankle must be flexible without skeletal deformity. The electromyography of the tibialis posterior should be present in the swing phase for the tendon transfer to function correctly. Techniques and pitfalls are described to plan and execute a successful tibialis posterior tendon transfer.

PMID: [35725039](#)

7. Gait stability in ambulant children with cerebral palsy during dual tasks

Sophie Wist, Lena Carcreff, Sjoerd M Bruijn, Gilles Allali, Christopher J Newman, Joel Fluss, Stéphane Armand

PLoS One. 2022 Jun 22;17(6):e0270145. doi: 10.1371/journal.pone.0270145. eCollection 2022.

Aim: The aim of this cross-sectional study was to measure the effect of dual tasks on gait stability in ambulant children with cerebral palsy (CP) compared to typically developing (TD) children. **Methods:** The children of the CP (n = 20) and TD groups (n = 20) walked first without a dual task, then while counting forward and finally while alternatively naming fruits and animals (DTf/a). They then completed the same cognitive exercises while sitting comfortably. We calculated the distance between the foot placement estimator (FPE) and the real foot placement in the anterior direction (DFPEAP) and in the mediolateral direction (DFPEML) as a measure of gait stability, in a gait laboratory using an optoelectronic system. Cognitive scores were computed. Comparisons within and between groups were analysed with linear mixed models. **Results:** The dual task had a significant effect on the CP group in DFPEAP and DFPEML. The CP group was more affected than the TD group during dual task in the DFPEML. Children in both groups showed significant changes in gait stability during dual tasks. **Interpretation:** The impact of dual task on gait stability is possibly due to the sharing of attention between gait and the cognitive task. All children favoured a 'posture second' strategy during the dual task of alternatively naming animals and fruits. Children with CP increased their mediolateral stability during dual task.

PMID: [35731795](#)

8. Effect of Hospital-Family Rehabilitation Intervention on Walking Function and Lower Limb Surface Electromyography in Children with Cerebral Palsy

Jing Wang, Ling Yue, Zhihong Chen, Bing Bai, Cuiying Chen

Randomized Controlled Trial Comput Math Methods Med. 2022 Jun 8;2022:7034670. doi: 10.1155/2022/7034670. eCollection 2022.

Objective: To explore the effect of hospital-family rehabilitation intervention on walking function and lower limb surface electromyography in children with cerebral palsy (CP). **Methods:** About 100 children with CP treated in our hospital from February 2019 to April 2021 were enrolled. The patients were randomly assigned into control group and study group. The control group received routine intervention, and the study group received hospital-family rehabilitation intervention. The intervention effect, GMFM88 scale score, IMM value, CR value, lower limb surface EMG value, and compliance of gastrocnemius muscle and tibialis anterior muscle were compared. **Results:** First of all, we compared the intervention effects. In the study group, 43 cases were markedly effective, 5 cases were effective, 1 case was improved, 1 case was ineffective, and the effective rate was 98.00%. In the control group, 22 cases were markedly effective, 14 cases were effective, 7 cases were improved, 7 cases were ineffective, and the effective rate of 86.00%. The intervention effect of the study group was better compared to the control group ($P < 0.05$). Secondly, we compared the scores of the GMFM88 scale. The scores of D area and E area and total score of the study group were higher compared to the control group ($P < 0.05$). The IEMG values of gastrocnemius muscle and tibialis anterior muscle were compared, and the IMM values of passive and active gastrocnemius muscle and tibialis anterior muscle in the study group were higher compared to the control group ($P < 0.05$). There exhibited no significant difference in CR value before intervention ($P > 0.05$). After intervention, the CR values of gastrocnemius muscle and tibialis anterior muscle in the study group were significantly lower compared to the control group ($P < 0.05$). In terms of the surface EMG of lower limbs, the EMG value of passive activity (gastrocnemius muscle, tibialis anterior muscle) in the study group was higher compared to the control group, and the EMG value of active activity was significantly lower compared to the control group ($P < 0.05$). Finally, we compared the compliance. In the study group, there were 43 cases of complete compliance, 7 cases of compliance, and 0 cases of noncompliance, with a compliance rate of 100.00%. In the control group, there were 32 cases of complete compliance, 11 cases of compliance, and 7 cases of noncompliance with a compliance rate of 86.00%. The compliance rate of the study group was better compared to the control group ($P < 0.05$). **Conclusion:** The intervention of hospital-family rehabilitation model is helpful to improve the self-care ability, cognitive function, and daily activities of children with CP, enhance the walking function and lower limb surface electromyography of children with SCP, and strengthen their qualities of life.

PMID: [35720026](#)

9. Causal Effects of Motor Control on Gait Kinematics After Orthopedic Surgery in Cerebral Palsy: A Machine-Learning Approach

Katherine M Steele, Michael H Schwartz

Front Hum Neurosci. 2022 Jun 3;16:846205. doi: 10.3389/fnhum.2022.846205. eCollection 2022.

Background: Altered motor control is common in cerebral palsy (CP). Understanding how altered motor control affects movement and treatment outcomes is important but challenging due to complex interactions with other neuromuscular impairments. While regression can be used to examine associations between impairments and movement, causal modeling provides a mathematical framework to specify assumed causal relationships, identify covariates that may introduce bias, and test model plausibility. The goal of this research was to quantify the causal effects of altered motor control and other impairments on gait, before and after single-event multi-level orthopedic surgery (SEMLS). **Methods:** We evaluated the impact of SEMLS on change in Gait Deviation Index (Δ GDI) between gait analyses. We constructed our causal model with a Directed Acyclic Graph that included the assumed causal relationships between SEMLS, Δ GDI, baseline GDI (GDIpre), baseline neurologic and orthopedic impairments (Imppre), age, and surgical history. We identified the adjustment set to evaluate the causal effect of SEMLS on Δ GDI and the impact of Imppre on Δ GDI and GDIpre. We used Bayesian Additive Regression Trees (BART) and accumulated local effects to assess relative effects. **Results:** We prospectively recruited a cohort of children with bilateral CP undergoing SEMLS ($N = 55$, 35 males, age: 10.5 ± 3.1 years) and identified a control cohort with bilateral CP who did not undergo SEMLS ($N = 55$, 30 males, age: 10.0 ± 3.4 years). There was a small positive causal effect of SEMLS on Δ GDI (1.70 GDI points). Altered motor control (i.e., dynamic and static motor control) and strength had strong effects on GDIpre, but minimal effects on Δ GDI. Spasticity and orthopedic impairments had minimal effects on GDIpre or Δ GDI. **Conclusion:** Altered motor control did have a strong effect on GDIpre, indicating that these impairments do have a causal effect on a child's gait pattern, but minimal effect on expected changes in GDI after SEMLS. Heterogeneity in outcomes suggests

there are other factors contributing to changes in gait. Identifying these factors and employing causal methods to examine the complex relationships between impairments and movement will be required to advance our understanding and care of children with CP.

PMID: [35721346](#)

10. Automatic gait event detection in pathologic gait using an auto-selection approach among concurrent methods

Mickael Fonseca, Raphaël Dumas, Stéphane Armand

Gait Posture. 2022 Jun 6;96:271-274. doi: 10.1016/j.gaitpost.2022.06.001. Online ahead of print.

Background: Accurate gait event detection is crucial to analyze pathological gait data. Existing methods relying on marker trajectories were reported to be sensitive to different gait patterns, which is an inherent characteristic of pathologic gait. **Research question:** We propose a new approach based on auto-selection among different methods, original and taken from the literature. **Methods:** The auto-selection approach evaluates the accuracy of the implemented methods for both foot-strike and foot-off on all available events detected by the force platforms, independently, and automatically selects the most accurate one to be used on the whole gait session. Pathological gait data from 272 patients with cerebral palsy and idiopathic toe walking were used retrospectively to evaluate the accuracy of this approach. Three methods previously reported in literature together with original methods developed based on auto-correlation were implemented and constituted our auto-selection approach. The accuracy and precision were compared to a recently reported method based on deep events as it is the method that showed the best performance in literature. **Results:** Results showed that the proposed approach outperformed all implemented methods used alone, with an accuracy of - 2.0 ms and - 0.9 ms for foot strike and foot-off, respectively. Additionally, more than 99% and 93% of events detected were detected within 20 ms and 10 ms of accuracy, respectively. **Significance:** The proposed methodology has demonstrated to improve the accuracy and precision of gait event detection in gait analysis.

PMID: [35716485](#)

11. Intervenções para promover função física de crianças e jovens com paralisia cerebral: diretriz internacional de prática clínica

Michelle Jackman, Leanne Sakzewski, Catherine Morgan, Roslyn N Boyd, Sue E Brennan, Katherine Langdon, Rachel A M Toovey, Sue Greaves, Megan Thorley, Iona Novak

Dev Med Child Neurol. 2022 Jun 21. doi: 10.1111/dmcn.15291. Online ahead of print.

Objetivo: Fornecer recomendações de intervenções para promoção da função física de crianças e jovens com paralisia cerebral. **MÉTODO:** Um painel de especialistas priorizou perguntas e desfechos importantes para o paciente. Usando o Grading of Recommendations Assessment, Development and Evaluation (GRADE), o painel avaliou a certeza das evidências e fez recomendações, com consultoria de especialistas internacionais e consumidores. **Resultados:** A diretriz compreende 13 recomendações (informadas por três revisões sistemáticas, 30 estudos randomizados e cinco estudos pré-pós). Para alcance de objetivos funcionais, recomenda-se que a intervenção inclua objetivos escolhidos pelo cliente, prática completa da tarefa em ambientes da vida real, suporte para empoderar as famílias e uma abordagem em equipe. Idade, habilidade e preferências da criança/família precisam ser consideradas. Para melhora da habilidade da marcha, recomenda-se marcha no solo, que pode ser complementada com treinamento em esteira. Várias abordagens podem facilitar os objetivos relacionados ao uso das mãos: terapia bimanual, terapia de contensão induzida, treino direcionado a objetivos e abordagens cognitivas. Para auto-cuidado, prática da tarefa completa, combinada com recursos assistivos podem aumentar a independência e reduzir a sobrecarga do cuidador. A participação em objetivos de lazer pode combinar prática da tarefa completa com estratégias direcionadas para barreiras ambientais, pessoais e sociais. **INTERPRETAÇÃO:** Intervenção para promoção da função de crianças e jovens com paralisia cerebral precisa incluir objetivos escolhidos pelo cliente e a prática da tarefa completa dos objetivos. Os clínicos devem considerar as preferências da criança/família, idade e habilidade ao selecionarem intervenções específicas.

PMID: [35729722](#)

12. Physical Activity Energy Expenditure Predicts Quality of Life in Ambulatory School-Age Children with Cerebral Palsy

Jinuk Lee, Min-Hwa Suk, Soojin Yoo, Jeong-Yi Kwon

J Clin Med. 2022 Jun 11;11(12):3362. doi: 10.3390/jcm11123362.

Background: Participation in physical activities is positively associated with better quality of life in children with cerebral palsy (CP). The objective of this study was to elucidate the relationship between the intensity of habitual physical activity (HPA) measured with an accelerometer and health-related quality of life (HRQOL) in school-age children with CP. **Method:** A secondary analysis of the cross-sectional data of 46 ambulatory children with CP was conducted. The participants wore an accelerometer for seven days to measure HPA: activity counts (counts/min) and physical activity energy expenditure (PAEE, kcal/kg/day), as well as %moderate-to-vigorous intensity physical activity (%MVPA), %light intensity physical activity (%LPA), and %sedentary physical activity (%SPA) were measured. Pediatric Quality of Life Inventory (PedsQL) 4.0 Generic Core Scales and Child Health Questionnaire Parent Form 50 Questions (CHQ-PF50) were used to measure HRQOL. A Pearson analysis and a hierarchical regression analysis were performed. **Results:** PAEE significantly predicted the results of the PedsQL (child) physical domain ($\beta = 0.579$, $p = 0.030$), PedsQL(child) emotional domain ($\beta = 0.570$, $p = 0.037$), PedsQL(child) social domain ($\beta = 0.527$, $p = 0.043$), and PedsQL(child) total ($\beta = 0.626$, $p = 0.017$). However, other HPA parameters could not predict any other HRQOL. **Conclusions:** PAEE could be used as a biomarker in studies on HRQOL and HPA in ambulatory school-age children with CP.

PMID: [35743433](#)

13. Effect of power training on locomotion capacities in children with cerebral palsy with GMFCS level III-IV

Sofia Smati, Annie Pouliot-Laforte, Mathilde Chevalier, Martin Lemay, Laurent Ballaz

Disabil Rehabil. 2022 Jun 23;1-7. doi: 10.1080/09638288.2022.2090623. Online ahead of print.

Purpose: Power training (PT) is a promising training modality to improve functional abilities in children with cerebral palsy (CP). This study aimed to implement PT in an adapted school and to assess its effect on locomotion capacities in children with Gross Motor Function Classification System (GMFCS) level III-IV. **Materials and methods:** Nine children with CP (GMFCS level III-IV) were trained three times/week for 12 weeks. The training sessions took place during the 50-minute physical activity classes and included high intensity exercise. The outcome measures were the performance on the 10-meter comfortable and fast walking tests, the 50-meter sprint test (50M-ST), and the energy expenditure index (EEI). **Results:** Participants spent 12 ± 7 and 7 ± 9 min per session at an intensity superior to 40% and 60% of the heart rate reserve, respectively. Performance in the 10-meter walking test (13.5 ± 7.8 to 9.9 ± 4.6 s, $p < 0.05$), the 10-meter fast walking test (8.8 ± 3.1 to 7.0 ± 3.2 s, $p < 0.05$), the 6-minute walking exercise (199.0 ± 48.6 to 316.6 ± 107.2 m, $p < 0.05$), and in 50M-ST (53.8 ± 29.5 to 42.3 ± 16.2 s, $p < 0.05$) increased after training. The EEI was reduced after training ($p = 0.01$), resulting in a more efficient gait. **Conclusions:** PT was successfully implemented in children with CP with GMFCS level III-IV. Results suggest that PT increases walking capacities. **Implications for rehabilitation:** Power training (PT) is feasible with children with bilateral cerebral palsy with GMFCS level III and IV. Physical education course in specialist school is a valuable environment to implement PT in children with poor gross motor function. Power training results in locomotion capacities improvement.

PMID: [35737476](#)

14. The Effects of an Online-Offline Hybrid Exercise Program on the Lives of Children with Cerebral Palsy Using Wheelchairs during the COVID-19 Pandemic in Korea

Youngshin Lim, Areum Han, Mingoo Lee, May Kim

Int J Environ Res Public Health. 2022 Jun 12;19(12):7203. doi: 10.3390/ijerph19127203.

Due to the ongoing COVID-19 pandemic, many online programs for social meetings, education, leisure, and physical activities have been developed and provided; however, children with cerebral palsy (CP) cannot enjoy online programs in the same way that those without disabilities can. The aim of this study was to investigate the differences in reintegration to normal living (RNL), social interaction, and quality of life among school-age children with CP after participation in a game-based online-

offline hybrid group exercise program. The current study was conducted on 26 children with CP who participated in a hybrid exercise program. The RNL, social interaction, and quality of life were measured before and after the six-week program. The scores of RNL and quality of life were improved ($p < 0.05$) after program participation. Online or hybrid exercise programs incorporating interactive methods (i.e., competition and cooperating) could enhance RNL and quality of life of children with CP. Thus, well-designed online or hybrid exercise programs should be developed and provided for children with CP to enhance overall quality of life during the pandemic.

PMID: [35742452](#)

15. Effectiveness of neuromuscular electrical stimulation in improving mobility in children with cerebral palsy: A systematic review and meta-analysis of randomized controlled trials

Yu-Hsuan Chen, Hsun-Yi Wang, Chun-De Liao, Tsan-Hon Liou, Reuben Escorpizo, Hung-Chou Chen

Clin Rehabil. 2022 Jun 21;2692155221109661. doi: 10.1177/02692155221109661. Online ahead of print.

Objective: To investigate whether neuromuscular electrical stimulation improves mobility in children with spastic cerebral palsy. **Methods:** PubMed, Cochrane, EMBASE, and Scopus were searched for randomized controlled trials studying the effects of NMES on the lower limbs in children with spastic CP. Randomized controlled trials comparing the effect of neuromuscular electrical stimulation with that of placebo or conventional therapy on mobility in children with cerebral palsy were eligible for inclusion. Two reviewers independently screened studies, extracted data, and examined the risk of bias and quality of evidence by using the revised Cochrane Risk-of-Bias Tool for Randomized Trials (RoB 2.0) and the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) method. The final search was conducted on May 23, 2022. **Results:** A total of 14 randomized controlled trials (2 crossover studies and 12 parallel studies including 421 patients) were included in this meta-analysis. Compared with the control group (conventional physical therapy), the treatment group exhibited greater improvement in walking speed (standardized mean difference = 0.29; 95% confidence interval = 0.02-0.57) and the standing, walking, running, and jumping dimension of the Gross Motor Function Measure (standardized mean difference = 1.24; 95% confidence interval = 0.64-1.83). **Conclusion:** Neuromuscular electrical stimulation improved mobility in children with spastic cerebral palsy, particularly in standing, running, and jumping function, and it is safe for children with spastic cerebral palsy.

PMID: [35730135](#)

16. Supporting young adults with intellectual/developmental disabilities to deliver a peer mentoring intervention: Evaluating fidelity and resources required

Ariel Schwartz, I-Ting Hwang

J Appl Res Intellect Disabil. 2022 Jun 22. doi: 10.1111/jar.13022. Online ahead of print.

Background: Peer-delivered interventions are a best practice in mental health, yet no such intervention exists for young adults (YA) with intellectual/developmental disabilities with co-occurring mental health conditions. We evaluated YA with intellectual/developmental disabilities' ability to deliver a novel peer mentoring intervention with fidelity and the supports received. **Methods:** We coded audio-recorded mentoring sessions to evaluate if 4 mentors adhered to 'content' (e.g., psychoeducation) and 'quality' (e.g., validation) fidelity criteria (codes: yes/no). We conducted content analysis of mentor support logs and interviews with mentors', mentors' parents and teachers to describe the supports mentors received. **Results:** Average fidelity for content criteria ($M = 73.3\%$) was higher than quality criteria ($M = 60.0\%$). Weekly support addressed logistics, delivering content, interpersonal interactions, emotional support, professionalism, and organisation. Family members and teachers rarely provided additional support. **Conclusions:** With support, YA can deliver a peer mentoring intervention addressing mental health. Additional training activities will be developed to improve fidelity.

PMID: [35730690](#)

17. Sleep Disorders and Quality of Life in Children with Cerebral Palsy

Pramod Samota, Aaradhana Singh, Anju Aggarwal, Rajeev Malhotra

Indian J Pediatr. 2022 Jun 21. doi: 10.1007/s12098-022-04151-x. Online ahead of print.

Objectives: To determine sleep disorders and quality of life (QOL) in children with cerebral palsy (CP) and to find the association between them. **Methods:** This cross-sectional study included children (4-12 y) with CP (n = 117) and age- and gender-matched healthy controls (n = 117). Pediatric Sleep Questionnaire (PSQ) was used to record sleep-related symptoms. Sleep-related breathing disorder (SRBD) scale and sleep disturbance scale for children (SDSC) were used to evaluate sleep disorders. Cerebral palsy quality-of-life questionnaire for children (CPQOL-CHILD) was used to assess QOL. **Results:** Sleep disorders by SRBD scale (score ≥ 0.33) were significantly more in CP (n = 7, 6%) than controls [(n = 0, 0%) (p value 0.014, OR 15.95)]. Using T score > 70 by SDSC scale, sleep disorders were seen in 7.7% (n = 9) CP children and 0% (n = 0) in controls (p value 0.04, OR 20.6). Using T score ≥ 51 , 43.6% CP children and 17% controls had sleep disorders (p value 0.001, CI 2.1, 6.9). About 43.6% CP children had abnormal T score on at least one SDSC factor. Presence of epilepsy, motor disabilities, intellectual disabilities, and type of CP significantly correlated with sleep disorders. The overall SRBD scores and SDSC T scores of CP children were negatively correlated with QOL (r = -0.489, p < 0.001 and r = -0.445, p < 0.001, respectively). **Conclusion:** Sleep disorders are more common in CP which adversely affect QOL. Routine screening and appropriate treatment are suggested.

PMID: [35727526](#)

18. 10-year follow-up study found that motor-free intelligence quotient declined in children with mild to moderate cerebral palsy

Monika Coceski, Robyn Stargatt, Sarah Sherwell, Hisham M Abu-Rayya, Susan M Reid, Dinah S Reddihough, Jacquie Wrennall, Darren R Hocking

Acta Paediatr. 2022 Jun 23. doi: 10.1111/apa.16463. Online ahead of print.

Aim: This 10-year follow-up study examined cognitive change in a cohort of children with cerebral palsy from preschool to adolescence at the group and individual levels. **Methods:** The Wechsler Preschool and Primary Scale of Intelligence was administered to 80 children with cerebral palsy (mean = 4 years 6 months, standard deviation = 7 months) at baseline (Time 1). At 10-year follow up (Time 2), 28 adolescents (mean = 14 years 6 months, standard deviation = 9 months) returned for assessment with the Wechsler Intelligence Scale for Children. Motor-free intelligence quotient (IQ) scores were calculated and paired-samples t-tests and the Reliable Change Index (RCI) were used to investigate change in IQ over time. **Results:** At the group level, nonverbal IQ scores declined significantly. At the individual level, RCI indicated nine and 11 children showed a clinically significant decline in Full Scale IQ and nonverbal IQ scores, respectively. Decline in FSIQ was related to a history of seizures whereas decline in nonverbal IQ was associated with higher initial IQ. **Conclusion:** Cognitive abilities in children with cerebral palsy evolve over time and selective deficits may not be observable until a later age, highlighting the importance of repeated cognitive assessment throughout childhood and adolescence.

PMID: [35735126](#)

19. Accommodations to cognitive assessment for a child with dyskinetic cerebral palsy: case study

Petra Karlsson, Megan Shepherd, Ingrid Honan

Disabil Rehabil Assist Technol. 2022 Jun 22;1-7. doi: 10.1080/17483107.2022.2089244. Online ahead of print.

Purpose: Despite the importance of having knowledge about a child's cognitive functioning, less than one-third of children with cerebral palsy (CP) are formally assessed. Consequently, the cognitive strengths of many children with severe CP may be underestimated or go overlooked. This case study aimed to test accommodations to cognitive assessment administration procedures to enable switch access. **Methods:** A 9-year-old boy with dyskinetic CP tested a suite of cognitive assessments with accommodations for single switch access and measures of user experience. The cognitive assessment included: receptive vocabulary; non-verbal reasoning; sustained attention; executive functions of problem solving and shifting; and visual perception skills. **Results:** The participant's ability to independently undertake assessment on the receptive vocabulary, non-verbal reasoning and the sustained attention measures indicates that accommodations made for single switch access were appropriate. Assessment took 1-2 h longer than expected for a typically developing child via standardised administration procedures, but was considerably faster than expected if undertaken via low-tech partner assisted scanning. Accessibility barriers continued to be present for the executive function and visual perception measures. Overall, the user experience was positive, both in regards to usability and cognitive load. **Conclusions:** This case study provides emerging data for usability and accessibility of accommodations to a battery of cognitive assessment tasks. Further research is needed to devise appropriate accommodations for executive function and visual perception measures and to determine whether the accommodations are

accessible more generally for children with motor and/or speech impairments. Implications for rehabilitation: Accommodations can be successfully made to receptive vocabulary, non-verbal reasoning and sustained attention assessment administration procedures for switch technologies. Cognitive assessment with switch accommodations takes considerably longer to complete than standardised administration estimates for a typically developing child. Assessment may need to be scheduled over more than one session. User experience, including usability and cognitive load, of accommodations was positive.

PMID: [35730760](#)

20. Role of virtual reality and active video games in motor and executive functions in cerebral palsy: A systematic review

Asifa Qurat Ul Ain, Arooj Fatima, Faraya Yousaf, Filza Shoukat, Kashif Siddiqui, Ashfaq Ahmed

J Pak Med Assoc. 2022 May;72(5):929-934. doi: 10.47391/JPMA.2140.

Objective: To explore current evidence on the role of virtual reality and active video games in motor and executive functions compared to conventional physical therapies in cerebral palsy patients. **Methods:** The systematic review was conducted at the University Institute of Physical Therapy, Lahore, Pakistan, and comprised search on MEDLINE via PubMed, Pedro and Cochrane Central related to randomised and clinical controlled trials published from 2005 to 2020. For critical appraisal of the studies, the Pedro tool was used, while methodological quality assessment was done using the Cochrane risk of bias tool. **Results:** Of the 15 articles reviewed, 14(93.3%) reported significant effect of virtual reality and active video games on motor functions. Critical appraisal found the quality of the studies from fair to high. Low risk was found in 4(26.7%) articles in terms of selection, 3(20%) allocation, 6(40%) detection, and 8(53.3%) had attrition bias. Unclear risk was reported in the performance and reporting bias domain in all the 15(100%) articles. **Conclusions:** Virtual reality games cannot be used as a substitute for therapy, but along with the conventional physical therapy, they are very effective and produce significant changes in motor functions in cerebral palsy patients. As for executive functions, more research needs to be done to determine the impact of these games at a higher level of brain.

PMID: [35713058](#)

21. Pediatric powered mobility training: powered wheelchair versus simulator-based practice

Naomi Gefen, Philippe S Archambault, Amihai Rigbi, Patrice L Weiss

Assist Technol. 2022 Jun 23;1-10. doi: 10.1080/10400435.2022.2084183. Online ahead of print.

Method: Participants included 30 children and adolescents (23 males, 13 females) with cerebral palsy and other neuromuscular diseases, aged 6-18. Data were collected and compared at baseline and after 12 weeks of home-based practice via a powered wheelchair or a simulator. Powered mobility ability was determined by the Powered Mobility Program (PMP), the Israel Ministry of Health's Powered Mobility Proficiency Test (PM-PT) and the Assessment of Learning Powered Mobility (ALP). **Results:** All participants practiced for the required amount of time and both groups reported a similar user experience. Both groups achieved significant improvement following the practice period as assessed by the PMP and PM-PT assessments, with no significant differences between them. A significant improvement was found in the ALP assessment outcomes for the powered wheelchair group only. **Conclusions:** This is the first study, to our knowledge, that compares two different wheelchair training methods. Simulator-based practice is an effective training option for powered mobility for children with physical disabilities aged 6-18 years old, demonstrating that it is possible to provide driving skill practice opportunities safe, controlled environments.

PMID: [35737961](#)

22. Access to supportive mobility devices for children with cerebral palsy: A multitude of challenges and barriers

Brenda Agnew

Dev Med Child Neurol. 2022 Jun 18. doi: 10.1111/dmcn.15304. Online ahead of print.

No abstract available

PMID: [35716399](#)

23. Obesity and neurodevelopmental and mental health conditions among adolescents aged 10-17 years: The National Survey of Children's Health 2017-2018

Acadia W Buro, Abraham Salinas-Miranda, Jennifer Marshall, Heewon L Gray, Russell S Kirby

J Paediatr Child Health. 2022 Jun 24. doi: 10.1111/jpc.16081. Online ahead of print.

Aim: Adolescents have a high prevalence of obesity and neurodevelopmental and mental health co-occurring conditions. This study examined the association between obesity and several co-occurring conditions - autism spectrum disorder (ASD); intellectual disability; learning disability; stuttering, stammering or other speech problems; developmental delay; attention-deficit hyperactivity disorder; epilepsy or seizure disorder; cerebral palsy; depression; anxiety; and Tourette Syndrome - in adolescents aged 10-17 years (n = 26 266) using 2017-2018 National Survey of Children's Health data. **Methods:** This cross-sectional study used 2017-2018 National Survey of Children's Health data (n = 27 328); χ^2 tests were conducted to compare the prevalence of obesity and several co-occurring conditions. Multiple logistic regression was conducted to adjust for age, gender, race/ethnicity and household income. **Results:** Obesity prevalence was 15.3%. Adolescents with ASD (25.1%) and epilepsy/seizure disorder (27.8%) had the greatest obesity prevalence. Adjusting for socio-demographic characteristics, odds of obesity were higher in those with ASD (odds ratio (OR) 1.7, confidence interval (CI) 1.2-2.6), learning disability (OR 1.5, CI 1.2-2.0), epilepsy or seizure disorder (OR 2.2, CI 1.2-3.8) and depression (OR 2.0, CI 1.6-2.5). For all regression analyses, odds of obesity were higher among adolescents who were non-Hispanic Black, Hispanic and low-income. **Conclusions:** The increased prevalence of obesity in adolescents with ASD, learning disability, epilepsy or seizure disorder, and depression demonstrates the need to attend to their nutrition and physical activity needs. Future research should examine obesity risk factors among adolescents with specific neurodevelopmental and mental health conditions, as well as racial or ethnic minority and low-income populations, to properly tailor obesity prevention services.

PMID: [35748345](#)

24. Longitudinal Follow-Up of Gross Motor Function in Children with Congenital Zika Virus Syndrome from a Cohort in Rio de Janeiro, Brazil

Tatiana Hamanaka, Carla Trevisan M Ribeiro, Sheila Pone, Saint Clair Gomes, Karin Nielsen-Saines, Elizabeth B Brickley, Maria Elisabeth Moreira, Marcos Pone

Viruses. 2022 May 28;14(6):1173. doi: 10.3390/v14061173.

Knowledge of how congenital Zika syndrome (CZS) impacts motor development of children longitudinally is important to guide management. The objective of the present study was to describe the evolution of gross motor function in children with CZS in a Rio de Janeiro hospital. In children with CZS without arthrogryposis or other congenital osteoarticular malformations who were followed in a prospective cohort study, motor performance was evaluated at two timepoints using the Gross Motor Function Classification System (GMFCS) and the Gross Motor Function Measurement test (GMFM-88). Among 74 children, at the baseline evaluation, the median age was 13 (8-24) months, and on follow-up, 28 (24-48) months. According to GMFCS at the second timepoint, 6 children were classified as mild, 11 as moderate, and 57 as severe. In the GMFM-88 assessment, children in the severe group had a median score of 10.05 in the baseline evaluation and a follow-up score of 12.40, the moderate group had median scores of 25.60 and 29.60, and the mild group had median scores of 82.60 and 91.00, respectively. Although a small developmental improvement was observed, the motor impairment of children was mainly consistent with severe cerebral palsy. Baseline motor function assessments were predictive of prognosis.

PMID: [35746646](#)

25. Foetal amplitude-integrated electroencephalography: proof of principle of a novel foetal monitoring technique in adult volunteers

S Mires, R S Kerr, M Denbow, N Dahnoun, S Tancock, D Osredkar, E Chakkarapani

J Obstet Gynaecol. 2022 Jun 21;1-8. doi: 10.1080/01443615.2022.2081797. Online ahead of print.

Peripartum hypoxic neonatal brain injury cannot be accurately predicted with current foetal monitoring techniques. Neonatal brain monitoring through amplitude-integrated electroencephalography (aEEG) is utilised when brain injury is suspected. Intrapartum aEEG assessment may improve detection of foetal hypoxia, facilitating earlier intervention. Using different engineered configurations in adult volunteers (n = 18), we monitored aEEG through application of two foetal scalp electrodes (FSEs). This aided development of a novel signal splitter, our Foetal heart rate and aEEG Monitoring System (FEMS) to monitor aEEG intrapartum. We then compared FEMS with gold-standard EEG monitoring simultaneously in two adults. Average percentage of interpretable aEEG signal was 61.3%, with the FEMS obtaining 72.15%. EEG signal on the aEEG device consistently showed a similar trace to gold standard EEG. This study demonstrates feasibility of aEEG monitoring in adults with FEMS utilising FSE inputs. An intrapartum foetal study utilising FEMS is due to commence shortly. **IMPACT STATEMENT:** What is already known on this subject? Cardiotography, the current gold standard in foetal monitoring, is not associated with a reduction in cerebral palsy or infant mortality rates. Neonatal amplitude-integrated electroencephalography (aEEG) is an established method of monitoring brain function to guide commencing cooling therapy in suspected hypoxic brain injury. Intrapartum animal studies have illustrated foetal EEG changes reflecting evolving hypoxia. What do the results of this study add? This study demonstrates aEEG monitoring in human adult volunteers through application of foetal scalp electrodes and use of a novel signal splitter. This Foetal heart rate and aEEG Monitoring System (FEMS) provided a good overall percentage of aEEG signal, consistently showing a similar trace to gold standard EEG. What the implications are of these findings for clinical practice and/or further research? This proof of principle study provides the first step in developing a novel intrapartum foetal monitoring technique to monitor foetal aEEG in labour. This provides an exciting prospect of transferring well established neonatal monitoring techniques to facilitate accurate brain function assessment intrapartum and early intervention to reduce hypoxic brain injury. An intrapartum foetal study of this technology is due to begin in the near future.

PMID: [35727566](#)

26. LUNCH-Lung Ultrasound for early detection of silent and apparent aspiration in infants and young Children with cerebral palsy and other developmental disabilities: study protocol of a randomized controlled trial

S Fiori, R T Scaramuzzo, E Moretti, C Amador, T Controzzi, A Martinelli, L Filippi, A Guzzetta, L Gargagni

BMC Pediatr. 2022 Jun 23;22(1):360. doi: 10.1186/s12887-022-03413-z.

Background: Children with neurological impairment may have dysphagia and/or gastro-esophageal reflux disease (GERD), which predispose to complications affecting the airways, increasing risk for aspiration-induced acute and chronic lung disease, or secondarily malnutrition, further neurodevelopmental disturbances, stressful interactions with their caregivers and chronic pain. Only multidisciplinary clinical feeding evaluation and empirical trials are applied to provide support to the management of feeding difficulties related to dysphagia or GERD, but no standardized feeding or behavioral measure exists at any age to assess aspiration risk and support the indication to perform a videofluoroscopic swallowing study (VFSS) or a fibre-optic endoscopic examination of swallowing (FEES), in particular in newborns and infants with neurological impairments. Lung ultrasound (LUS) has been proposed as a non-invasive, radiation-free tool for the diagnosis of pulmonary conditions in infants, with high sensitivity and specificity. **Methods:** A RCT will be conducted in infants aged between 0 and 6 years having, or being at risk for, cerebral palsy, or other neurodevelopmental disease that determines abnormal muscular tone or motor developmental delay assessed by a quantitative scale for infants or if there is the suspicion of GERD or dysphagia based on clinical symptoms. Infants will be allocated in one of 2 groups: 1) LUS-monitored management (LUS-m); 2) Standard care management (SC-m) and after baseline assessment (T0), both groups will undergo an experimental 6-months follow-up. In the first 3 months, infants will be evaluated a minimum of 1 time per month, in-hospital, for a total of 3 LUS-monitored meal evaluations. Primary and secondary endpoint measures will be collected at 3 and 6 months. **Discussion:** This paper describes the study protocol consisting of a RCT with two main objectives: (1) to evaluate the benefits of the use of LUS for monitoring silent and apparent aspiration in the management of dysphagia and its impact on pulmonary illness and growth and (2) to investigate the impact of the LUS management on blood sample and bone metabolism, pain and interaction with caregivers. **Trial registration:** Trial registration date 02/05/2020; ClinicalTrials.gov Identifier: NCT04253951.

PMID: [35739502](#)

27. Automated Movement Analysis to Predict Cerebral Palsy in Very Preterm Infants: An Ambispective Cohort Study
Kamini Raghuram, Silvia Orlandi, Paige Church, Maureen Luther, Alex Kiss, Vibhuti Shah

Children (Basel). 2022 Jun 7;9(6):843. doi: 10.3390/children9060843.

The General Movements Assessment requires extensive training. As an alternative, a novel automated movement analysis was developed and validated in preterm infants. Infants < 31 weeks' gestational age or birthweight ≤ 1500 g evaluated at 3-5 months using the general movements assessment were included in this ambispective cohort study. The C-statistic, sensitivity, specificity, positive predictive value, and negative predictive value were calculated for a predictive model. A total of 252 participants were included. The median gestational age and birthweight were 274/7 weeks (range 256/7-292/7 weeks) and 960 g (range 769-1215 g), respectively. There were 29 cases of cerebral palsy (11.5%) at 18-24 months, the majority of which (n = 22) were from the retrospective cohort. Mean velocity in the vertical direction, median, standard deviation, and minimum quantity of motion constituted the multivariable model used to predict cerebral palsy. Sensitivity, specificity, positive, and negative predictive values were 55%, 80%, 26%, and 93%, respectively. C-statistic indicated good fit (C = 0.74). A cluster of four variables describing quantity of motion and variability of motion was able to predict cerebral palsy with high specificity and negative predictive value. This technology may be useful for screening purposes in very preterm infants; although, the technology likely requires further validation in preterm and high-risk term populations.

PMID: [35740780](#)

28. Reliability of the Modified Ashworth and Modified Tardieu Scales with Standardized Movement Speeds in Children with Spastic Cerebral Palsy

Myungeun Yoo, Jeong Hyeon Ahn, Dong-Wook Rha, Eun Sook Park

Children (Basel). 2022 Jun 3;9(6):827. doi: 10.3390/children9060827.

The Modified Ashworth Scale (MAS) and Modified Tardieu Scale (MTS) are widely used to quantify spasticity. However, the reliability of their use for ankle plantar flexors has been questioned. In this study, we aimed to examine whether their reliabilities could be increased to acceptable levels for ankle plantar flexors using standardized movement speed in children with spastic cerebral palsy. The MAS and MTS scores for 92 limbs were assessed by two raters on two occasions, 1 week apart. A metronome was used to maintain the stretching velocity at 120 beats per minute. The intraclass correlation coefficients (ICCs) of the intra-rater reliabilities of the MAS and MTS and inter-rater reliability of the MAS were over 0.7. However, the ICCs for the inter-rater reliability of the MTS were < 0.7 and > 0.75 for the gastrocnemius and soleus muscles, respectively. The ICCs for the inter- and intra-rater reliabilities of the R1 angles ranged from 0.68 to 0.84, while those of the R2 angles ranged from 0.74 to 0.93. The reliabilities of the R2-R1 angles were not satisfactory. In conclusion, with a standardized movement speed, the reliability of the MAS for the ankle plantar flexors and the MTS for the soleus were satisfactory; however, that of the MTS for the gastrocnemius was not.

PMID: [35740764](#)

29. Lanbotulinumtoxin-A: Safe for children with cerebral palsy but is it effective?

Tandy Hastings-Ison, Kerr Graham

Dev Med Child Neurol. 2022 Jun 23. doi: 10.1111/dmcn.15329. Online ahead of print.

PMID: [35746861](#)

30. Effect of rehabilitation on the long-term efficacy of botulinum toxin-A for spastic cerebral palsy

J-J Liu, Y Zhang, J Qi, F-Y Zeng, N-L Li

Eur Rev Med Pharmacol Sci. 2022 Jun;26(11):3927-3932. doi: 10.26355/eurrev_202206_28961.

Objective: To investigate the long-term effects of botulinum toxin-A (BTX-A) nerve block on relaxation of spasticity in cerebral palsy. **Patients and methods:** From June 2015 to December 2018, 52 children, aged 20-56 months, with spastic cerebral palsy were treated with BTX-A. The dose of BTX-A was selected based on the weight of the child and the modified Ashworth scale (MAS). The injection dose ranged from 45 IU to 150 IU (average 68.0±31.6 IU). The muscle tone and motor functions of all children were evaluated before the block. The spasticity was measured using the MAS, and the motor function was measured using the Physician Rating Scale (PRS) and the gross motor function measure (GMFM). After two years, all children were re-evaluated. **Results:** No significant difference was observed between the trial and control groups in terms of age, weight, MAS, PRS, and GMFM measurements before the block ($p>0.05$). The PRS and GMFM improved significantly in both groups after two years ($p<0.05$). The PRS and GMFM in the trial group increased more significantly than those in the control group ($p<0.05$). **Conclusions:** The BTX-A block showed a long-term positive effect. Rehabilitation training after the block could help children to improve their motor functions.

PMID: [35731062](#)**31. The Effect of Botulinum Toxin-A on Chronic Muscle-Related Pain in Cerebral Palsy**

Christian Wong

Front Neurol. 2022 Jun 3;13:936625. doi: 10.3389/fneur.2022.936625. eCollection 2022.

No abstract available

PMID: [35720091](#)**32. Home-Based Measurements of Dystonia in Cerebral Palsy Using Smartphone-Coupled Inertial Sensor Technology and Machine Learning: A Proof-of-Concept Study**

Dylan den Hartog, Marjolein M van der Krogt, Sven van der Burg, Ignazio Aleo, Johannes Gijsbers, Laura A Bonouvrié, Jaap Harlaar, Annemieke I Buizer, Helga Haberfehlner

Sensors (Basel). 2022 Jun 9;22(12):4386. doi: 10.3390/s22124386.

Accurate and reliable measurement of the severity of dystonia is essential for the indication, evaluation, monitoring and fine-tuning of treatments. Assessment of dystonia in children and adolescents with dyskinetic cerebral palsy (CP) is now commonly performed by visual evaluation either directly in the doctor's office or from video recordings using standardized scales. Both methods lack objectivity and require much time and effort of clinical experts. Only a snapshot of the severity of dyskinetic movements (i.e., choreoathetosis and dystonia) is captured, and they are known to fluctuate over time and can increase with fatigue, pain, stress or emotions, which likely happens in a clinical environment. The goal of this study was to investigate whether it is feasible to use home-based measurements to assess and evaluate the severity of dystonia using smartphone-coupled inertial sensors and machine learning. Video and sensor data during both active and rest situations from 12 patients were collected outside a clinical setting. Three clinicians analyzed the videos and clinically scored the dystonia of the extremities on a 0-4 scale, following the definition of amplitude of the Dyskinesia Impairment Scale. The clinical scores and the sensor data were coupled to train different machine learning models using cross-validation. The average F1 scores (0.67 ± 0.19 for lower extremities and 0.68 ± 0.14 for upper extremities) in independent test datasets indicate that it is possible to detect dystonia automatically using individually trained models. The predictions could complement standard dyskinetic CP measures by providing frequent, objective, real-world assessments that could enhance clinical care. A generalized model, trained with data from other subjects, shows lower F1 scores (0.45 for lower extremities and 0.34 for upper extremities), likely due to a lack of training data and dissimilarities between subjects. However, the generalized model is reasonably able to distinguish between high and lower scores. Future research should focus on gathering more high-quality data and study how the models perform over the whole day.

PMID: [35746168](#)

33. Top 10 Research Themes for Dystonia in Cerebral Palsy: A Community-Driven Research Agenda

Laura A Gilbert, Darcy L Fehlings, Paul Gross, Michael C Kruer, Wendy Kwan, Jonathan W Mink, Michele Shusterman, Bhooma R Aravamuthan, and the Cerebral Palsy Research Network Dystonia Study Group

Neurology. 2022 Jun 17;10.1212/WNL.000000000200911. doi: 10.1212/WNL.000000000200911. Online ahead of print.

Dystonia in cerebral palsy (DCP) is a common, debilitating, but under-studied condition. The CP community (people with CP and caregivers) is uniquely equipped to help determine the research questions that best address their needs. We developed a community-driven DCP research agenda using the well-established James Lind Alliance methodology. CP community members, researchers, and clinicians were recruited via multiple advocacy, research, and professional organizations. To ensure shared baseline knowledge, participants watched webinars outlining our current knowledge on DCP prepared by a Steering Group of field experts (cprn.org/research-cp-dystonia-edition). Participants next submitted their remaining uncertainties about DCP. These were vetted by the Steering Group and consolidated to eliminate redundancy to generate a list of unique uncertainties which were then prioritized by the participants. The top prioritized uncertainties were aggregated into themes via iterative consensus-building discussions within the Steering Group. 166 webinar viewers generated 67 unique uncertainties. 29 uncertainties (17 generated by community members) were prioritized higher than their randomly matched pairs. These were coalesced into the following Top 10 DCP Research Themes: 1) Develop new treatments; 2) Assess rehabilitation, psychological, and environmental management approaches; 3) Compare effectiveness of current treatments; 4) Improve diagnosis and severity assessments; 5) Assess the impact of mixed tone (spasticity and dystonia) in outcomes and approaches; 6) Assess predictors of treatment responsiveness; 7) Determine pathophysiologic mechanisms; 8) Describe the natural history; 9) Develop dystonia pain treatments; 10) Increase family awareness. This community-driven research agenda reflects the concerns most important to the community, both in perception and in practice. We therefore encourage future DCP research to center around these themes. Furthermore, noting that community members (not clinicians or researchers) generated the majority of top-prioritized uncertainties, our results highlight the important contributions community members can make to research agendas, even beyond DCP.

PMID: [35715199](https://pubmed.ncbi.nlm.nih.gov/35715199/)

34. Methicillin-resistant Staphylococcus aureus nasal colonization in children with cerebral palsy

Diego Schaps, Reilly Dever, Victoria M Parente, Deverick J Anderson, Ibukunoluwa C Kalu

Infect Control Hosp Epidemiol. 2022 Jun 23;1-3. doi: 10.1017/ice.2022.149. Online ahead of print.

A retrospective cohort of children admitted to the pediatric intensive care unit (PICU) with cerebral palsy was matched 1:3 by age and admission year to determine odds of methicillin-resistant Staphylococcus aureus (MRSA) nasal colonization. Adjusted odds of MRSA nasal colonization at PICU admission were 2.6-fold higher among children with cerebral palsy.

PMID: [35732616](https://pubmed.ncbi.nlm.nih.gov/35732616/)

35. Incontinence training in children with cerebral palsy: A prospective controlled trial

Bieke Samijn, Christine Van den Broeck, Frank Plasschaert, Aurelie Pascal, Ellen Deschepper, Piet Hoebeke, Erik Van Laecke

J Pediatr Urol. 2022 May 25;S1477-5131(22)00212-1. doi: 10.1016/j.jpuro.2022.05.014. Online ahead of print.

Introduction: Urinary incontinence is the most frequently observed lower urinary tract symptom in children with cerebral palsy (CP). Being continent can positively influence quality of life of the child and the social environment. Objective: To investigate the effectiveness of incontinence training with urotherapy in children with CP. Study design: A population-based case-control study was conducted including 21 children with CP and 24 typically developing children between 5 and 12 years old, both with daytime incontinence or combined daytime incontinence and enuresis. Children received treatment for one year with three-monthly examination by means of uroflowmetry, a structured questionnaire and bladder diaries. Children started with three months of standard urotherapy. After three, six and nine months of training, specific urotherapy interventions (pelvic floor muscle training with biofeedback, alarm treatment or neuromodulation) and/or pharmacotherapy could be added to the initial treatment. Therapy was individualized to probable underlying conditions. Effectiveness was controlled for spontaneous

improvement due to maturation and analysed by means of longitudinal linear models, generalized estimating equations and multilevel cumulative odds models. Comparison with typically developing children was assessed by means of Kaplan-Meier survival analysis. Results: Results suggest effectivity rate of incontinence training is lower and changes occur more slowly in time in children with CP compared to typically developing children (Figure). Within the group of children with CP, significant changes during one year of training were found for daytime incontinence ($p < 0.001$), frequency of daytime incontinence ($p = 0.002$), frequency of enuresis ($p = 0.048$), storage symptoms ($p = 0.011$), correct toilet posture ($p = 0.034$) and fecal incontinence ($p = 0.026$). Discussion: Maximum voided volume and fluid intake at the start of training were significantly lower in children with CP and could explain a delayed effectiveness of urotherapy. Treatment of constipation demonstrated a positive effect on maximum voided volume and should be initiated together with standard urotherapy when constipation is still present after implementation of a correct fluid intake schedule. Future research with a larger sample size is recommended. Conclusions: Incontinence training with urotherapy can be an effective treatment for urinary incontinence in children with cerebral palsy. In the current cohort, effectivity rate of incontinence training was lower and changes occurred more slowly in children with cerebral palsy compared to typically developing children.

PMID: [35732572](#)

36. Body Fat Distribution in Children and Adolescents With Cerebral Palsy

Kim Ramona Ewert, Alexandra Semmelweis, Johanna Heistermann, Leonie Schafmeyer, Eckhard Schoenau, Ibrahim Duran

J Clin Densitom. 2022 May 26;S1094-6950(22)00047-6. doi: 10.1016/j.jocd.2022.05.002. Online ahead of print.

To evaluate the body fat distribution in children with cerebral palsy (CP). The present study focusses on a monocentric retrospective analysis of body fat distribution from children diagnosed with CP. The children participated in a rehabilitation program. Reference centiles were calculated based on data from the National Health and Nutrition Examination Survey (NHANES, 1999-2004). Z-scores for trunk-to-leg fat ratio were calculated. Further, fat mass index (FMI) was evaluated based on percentiles that have already been published. 237 males and 194 females with CP were considered (mean age: 11 years and 11 months [SD 3 years]). These were compared to 1059 males and 796 females from the NHANES (mean age: 14 years and 7 months [SD 3 years and 4 months]). The z-scores for trunk-to-leg fat ratio showed the following values: mean -0.47 (SD 1.50) for males, -0.49 (SD 1.11), for females, -0.48 (SD 1.34) for all. The z-scores for FMI showed the following values: mean -0.29 (SD 0.70) for males, -0.88 (SD 2.0) for females, -0.55 (SD 1.46) for all. The results showed rather a gynoid fat distribution and a lower FMI in children with CP than in the reference population (NHANES 1999-2004).

PMID: [35710756](#)

37. Transition to adult services experienced by young people with cerebral palsy: A cross-sectional study

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

Dev Med Child Neurol. 2022 Jun 21. doi: 10.1111/dmcn.15317. Online ahead of print.

Aim: To assess if young people with cerebral palsy experience and health professionals provide practices that may improve transition from child to adult health services. Method: Seventy-five young people (31 females, 44 males; mean age 18 years 5 months [standard deviation 2 years 2 months]) and/or parents and 108 health professionals completed a questionnaire describing their experience or the provision of nine transition practices. Results: The percentage of young people reporting each practice was: appropriate parent involvement (90%); promotion of health self-efficacy (37%); named worker who supports the transition process (36%); self-management support for physical health (36%); self-management support for mental health (17%); information about the transition process (24%); meeting the adult team (16%); and life skills training (16%). Post-discharge, 10% of young people reported that their general practitioner (GP) received a discharge letter. The percentage of health professionals reporting each practice was: promotion of health self-efficacy (73.2%); self-management support (73.2%); information (69%); consulting the parent and young person about parent involvement (63% and 66%); discharge letter to a GP (55%); life skills training (36%); named worker (35%); meeting the adult team (30%); and senior manager (20%). Interpretation: Many young people did not experience practices that may improve the experience and outcomes of transition. Young people should be involved in the development and delivery of transition to ensure it meets their needs.

PMID: [35729753](#)

38. Aberrant movement-related somatosensory cortical activity mediates the extent of the mobility impairments in persons with cerebral palsy

Michael P Trevarrow, Brittany K Taylor, Anna M Reelfs, Tony W Wilson, Max J Kurz

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Key points: Persons with cerebral palsy (CP) have reduced somatosensory cortical responses at rest and during movement. The somatosensory cortical responses during movement mediate the relationship between the somatosensory cortical responses at rest and mobility. Persons with CP may have altered sensorimotor feedback that ultimately contributes to impaired mobility.

Abstract: There are numerous clinical reports that persons with cerebral palsy (CP) have proprioceptive, stereognosis and tactile discrimination deficits. The current consensus is that these altered perceptions are attributable to aberrant somatosensory cortical activity. It has been inferred from these data that persons with CP do not adequately process ongoing sensory feedback during motor actions, which accentuates the extent of their mobility impairments. However, this hypothesis has yet to be directly tested. We used magnetoencephalographic (MEG) brain imaging to address this knowledge gap by quantifying the somatosensory dynamics evoked by applying electrical stimulation to the tibial nerve in 22 persons with CP and 25 neurotypical (NT) controls while at rest and during an ankle plantarflexion isometric force motor task. We also quantified the spatiotemporal gait biomechanics of participants outside the scanner. Consistent with the literature, our results confirmed that the strength of somatosensory cortical activity was weaker in the persons with CP compared to the NT controls. Our results also showed that the strength of the somatosensory cortical responses were significantly weaker during the isometric ankle force task than at rest. Most importantly, our results showed that the strength of somatosensory cortical activity during the ankle plantarflexion force production task mediated the relationship between somatosensory cortical activity at rest and both walking velocity and step length. These results suggest that youth with CP have aberrant somatosensory cortical activity during isometric force generation, which ultimately contributes to the extent of mobility impairments seen in this patient population.

Abstract figure legend Magnetoencephalographic brain imaging was used to determine the effect of sensory feedback during movement on mobility in persons with cerebral palsy. Persons with cerebral palsy had reduced somatosensory cortical activity at rest and during movement compared with their neurotypical peers. Further, the somatosensory cortical activity during movement mediated the relationship between somatosensory cortical activity at rest and mobility. These results indicate that difficulties in sensorimotor integration may contribute to the mobility impairments seen in this patient population. This article is protected by copyright. All rights reserved.

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39. Multi-Hit White Matter Injury-Induced Cerebral Palsy Model Established by Perinatal Lipopolysaccharide Injection

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Cerebral palsy (CP) is a group of permanent, but not unchanging, disorders of movement and/or posture and motor function. Since the major brain injury associated with CP is white matter injury (WMI), especially, in preterm infants, we established a "multi-hit" rat model to mimic human WMI in symptomatology and at a histological level. In our WMI model, pups suffering from limb paresis, incoordination, and direction difficulties fit the performance of CP. Histologically, they present with fewer neural cells, inordinate fibers, and more inflammatory cell infiltration, compared to the control group. From the electron microscopy results, we spotted neuronal apoptosis, glial activation, and myelination delay. Besides, the abundant appearance of IBA1-labeled microglia also implied that microglia play a role during neuronal cell injury. After activation, microglia shift between the pro-inflammatory M1 type and the anti-inflammatory M2 type. The results showed that LPS/infection stimulated IBA1 + (marked activated microglia) expression, downregulated CD11c + (marked M1 phenotype), and upregulated Arg 1 + (marked M2 phenotype) protein expression. It indicated an M1 to M2 transition after multiple infections. In summary, we established a "multi-hit" WMI-induced CP rat model and demonstrated that the microglial activation correlates tightly with CP formation, which may become a potential target for future studies.

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