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Cerebral palsy research news

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Interventions and Management

1. Impact of Sensory Deficits on Upper Limb Motor Performance in Individuals with Cerebral Palsy: A Systematic Review
Isabelle Poitras, Ophélie Martinie, Maxime T Robert, Alexandre Campeau-Lecours, Catherine Mercier

Review Brain Sci. 2021 Jun 3;11(6):744. doi: 10.3390/brainsci11060744.

People living with cerebral palsy (CP) exhibit motor and sensory impairments that affect unimanual and bimanual functions. The importance of sensory functions for motor control is well known, but the association between motor and sensory functions remains unclear in people living with CP. The objective of this systematic review was to characterize the relationship between sensory deficits and upper limb motor function in individuals living with CP. Methods: Five databases were screened. The inclusion criteria were: (1) including people living with CP, (2) reporting measurements of upper limb motor and sensory functions. A qualitative analysis of the studies' level of evidence was done. Results: Thirty-three articles were included. Twenty-five articles evaluated tactile functions, 10 proprioceptive functions and 7 visual functions; 31 of the articles reported on unimanual functions and 17 of them reported on bimanual functions. Tactile functions showed a moderate to high association; it was not possible to reach definitive conclusions for proprioceptive and visual functions. Conclusions: The heterogeneity of the results limits the ability to draw definitive conclusions. Further studies should aim to perform more comprehensive assessments of motor and sensory functions, to determine the relative contribution of various sensory modalities to simple and more complex motor functions.

PMID: 34205153

2. A New Method for Postural Misalignment of a 6-Year-Old Girl With Cerebral Palsy: A Case Report
Ying Hou, Huitian Zheng, Jinping Li, Shujia Wang, Dongmei Zhang, Tong Tang, Mindan Xu, Hong Zhou

Case Reports Arch Rehabil Res Clin Transl. 2021 Feb 23;3(2):100116. doi: 10.1016/j.arrct.2021.100116. eCollection 2021 Jun.

Objective: To demonstrate the effects of a newly designed postural alignment relearning system on postural control dysfunction in a typical patient with cerebral palsy (CP). Design: Evaluation before and after 8 weeks of Constraint Standing Training 3-dimensional postural alignment relearning system. Setting: Department of Rehabilitation Medicine. Participant: A 6-year-old girl with CP and postural misalignment on Gross Motor Function Classification System level I. Interventions: Constraint Standing Training for 8 weeks to correct postural misalignment. Main outcome measures: Parameters of lateral plain radiographs in static standing, posturography measurements in standing and walking, motor ability (Gross Motor Function Measure-88 [GMFM-88] scores, manual muscle testing [MMT] scores, muscle architecture), and gait kinematic parameters (40 3-dimensional parameters of arms, trunk, waist, and lower limbs). Results: Knee hyperextension angle in static

standing; peaks of knee flexion angle (KFA) when walking, hip flexion angle and ankle flexion angle in dynamic standing; and the KFA at initial contact in gait cycle all decreased significantly (P<.01). Scores of GMFM-88 sections D and E and MMT of 5 core stability muscles improved (P<.01). The velocities and range of motion of the arms, the 3-dimensinoal range of motion of the trunk and waist, and most of the parameters of the lower limbs showed statistically significant change (P<.01). Bilateral muscle thickness did not change significantly after the treatment (P=.738 left, P=.978 right), but the gluteus maximus morphology was changed: the muscle fibers became rounder, the interfiber space decreased, and the border lines of the muscle fibers got clearer. Conclusions: Postural alignment, motor ability, and gait may be homologous external manifestations of more fundamental core abilities, referring to correct standing posture cognition, muscle activation, and postural unconsciousness. Constraint Standing Training 3-dimensional postural alignment relearning system aimed to improve the static and dynamic standing control ability, may fix postural misalignment and improve motor ability and flexed-knee gait. Future work should use Constraint Standing Training with patients with different kinds of misalignment, choose sensitive indicators, observe the duration of each step, and reveal the mechanism causes postural misalignment.

PMID: 34179752

3. Total Hip Arthroplasty in Patients With Cerebral Palsy: A Matched Comparison of 90-Day Adverse Events and 5-Year Implant Survival
Harold G Moore, Mursal Gardezi, Patrick J Burroughs, Lee E Rubin, David B Frumberg, Jonathan N Grauer

J Arthroplasty. 2021 Jun 5;S0883-5403(21)00522-2. doi: 10.1016/j.arth.2021.05.039. Online ahead of print.

Background: People with cerebral palsy (CP) may be considered for total hip arthroplasty (THA). However, short- and long-term outcomes after THA in this population remain poorly characterized. Methods: Data from patients undergoing THA were abstracted from the 2010-2018 PearlDiver Mariner administrative database. Those with CP were matched to those without CP based on demographic and comorbid factors (1:4 matching). Ninety-day incidence of postoperative complications and hospital readmission was identified and compared. Five-year implant survival (based on need for revision) was also assessed and compared. Perioperative adverse events were then compared using multivariate logistic regression to adjust for any potential residual differences in demographic and comorbid factors after matching. Implant survival over time was compared with Kaplan-Meier plots with a log-rank test. Significance was set at P < .05 for all comparisons. Results: In total, 864 patients with CP were matched to 3448 patients without CP. After adjusting for differences in demographics and comorbidities, multivariate analyses demonstrated patients with CP had higher odds of urinary tract infection (odds ratio [OR] = 2.42, P = .007), pneumonia (OR = 3.77, P = .001), and periprosthetic fracture (OR = 2.55, P = .001). Rates of the other studied adverse events, including readmissions, were not significantly different between groups. At five years, 94.2% of the CP cohort and 95.2% of the non-CP cohort THAs remained unrevised (no difference by log rank, P = .195). Conclusion: Compared with patients without CP, patients with CP undergoing THA were found to have higher odds of perioperative urinary tract infection, pneumonia, and periprosthetic fracture but not other perioperative complications or difference in five-year implant survival.

PMID: 34176692

4. Distal rectus femoris surgery in children with cerebral palsy: results of a Delphi consensus project
Robert M Kay, Kristan Pierz, James McCarthy, H Kerr Graham, Henry Chambers, Jon R Davids, Unni Narayanan, Tom F Novacheck, Jason Rhodes, Erich Rutz, Jeffrey Shilt, Benjamin J Shore, Matthew Veerkamp, M Wade Shrader, Tim Theologis, Anja Van Campenhout, Thomas Dreher

J Child Orthop. 2021 Jun 1;15(3):270-278. doi: 10.1302/1863-2548.15.210044.

Purpose: The purpose of this study was for an international panel of experts to establish consensus indications for distal rectus femoris surgery in children with cerebral palsy (CP) using a modified Delphi method. Methods: The panel used a five-level Likert scale to record agreement or disagreement with 33 statements regarding distal rectus femoris surgery. The panel responded to statements regarding general characteristics, clinical indications, computerized gait data, intraoperative techniques and outcome measures. Consensus was defined as at least 80% of responses being in the highest or lowest two of the five Likert ratings, and general agreement as 60% to 79% falling into the highest or lowest two ratings. There was no agreement if neither threshold was reached. Results: Consensus or general agreement was reached for 17 of 33 statements (52%). There was general consensus that distal rectus femoris surgery is better for stiff knee gait than is proximal rectus femoris release. There was no consensus about whether the results of distal rectus femoris release were comparable to those following distal rectus femoris transfer. Gross Motor Function Classification System (GMFCS) level was an important factor for the panel, with the best outcomes expected in children functioning at GMFCS levels I and II. The panel also reached consensus that they do distal

rectus femoris surgery less frequently than earlier in their careers, in large part reflecting the narrowing of indications for this surgery over the last decade. Conclusion: This study can help paediatric orthopaedic surgeons optimize decision-making for, and outcomes of, distal rectus femoris surgery in children with CP.

PMID: 34211604

5. Does Ankle Exoskeleton Assistance Impair Stability During Walking in Individuals with Cerebral Palsy?
Taryn A Harvey, Benjamin C Conner, Zachary F Lerner

Ann Biomed Eng. 2021 Jun 29. doi: 10.1007/s10439-021-02822-y. Online ahead of print.

Lower-limb exoskeletons have the potential to improve mobility in individuals with movement disabilities, such as cerebral palsy (CP). The goal of this study was to assess the impact of plantar-flexor assistance from an untethered ankle exoskeleton on dynamic stability during unperturbed and perturbed walking in individuals with CP. Seven participants with CP (Gross Motor Function Classification System levels I-III, ages 6-31 years) completed a treadmill walking protocol under their normal walking condition and while wearing an ankle exoskeleton that provided adaptive plantar-flexor assistance. Pseudo-randomized treadmill perturbations were delivered during stance phase by accelerating one side of a split-belt treadmill. Treadmill perturbations resulted in a significant decrease in anteroposterior minimum margin-of-stability (- 32.1%, $p < 0.001$), and a significant increase in contralateral limb step length (8.1%, $p = 0.005$), integrated soleus activity during unassisted walking (23.4%, $p = 0.02$), and peak biological ankle moment (9.6%, $p = 0.03$) during stance phase. Plantar-flexor assistance did not significantly alter margin-of-stability, step length, soleus activity, or ankle moments during both unperturbed and perturbed walking. These results indicate that adaptive plantar-flexor assistance from an untethered ankle exoskeleton does not significantly alter dynamic stability maintenance during unperturbed and perturbed walking for individuals with CP, supporting future research in real-world environments.

PMID: 34189633

6. Stretch-shortening cycle exercises can efficiently optimize gait-symmetry and balance capabilities in children with unilateral cerebral palsy: A randomized controlled trial
Ragab K Elnaggar, Bader A Alqahtani, Saud F Alsubaie, Rania R Mohamed, Mohammed F Elbanna

NeuroRehabilitation. 2021 Jun 23. doi: 10.3233/NRE-210063. Online ahead of print.

Background: Children with unilateral cerebral palsy (UCP) experience an asymmetrical gait pattern and poor balance capabilities. Effective interventions, therefore, are needed to facilitate remediation of these functional issues. Objective: This study was set out to investigate the emerging role of stretch-shortening cycle (SSC) exercises on gait-symmetry and balance in children with UCP. Methods: In this randomized controlled trial, 42 children with UCP (age; 8 -12 years) were enrolled and received either standard physical rehabilitation (control group; n = 21) or the SSC exercise program plus physical rehabilitation (SSC group; n = 21). Spatial- and temporal-gait symmetry index (GSI) and specific balance capabilities [reactive balance, directional control, movement synchronization, and sensory organization] were assessed before and after 16 sessions that were carried out twice/week over non-sequential days in an 8-week program. Results: Using the pre-treatment scores as covariates, the post-treatment spatial- ($P = 0.006$; $\eta p2 = 0.17$) and temporal- GSI ($P < .001$; $\eta p2 = 0.46$) scores reduced significantly in the SSC group as compared to the control group, suggesting favorable improvement of gait symmetry. Also, all measures of balance ($P < 0.05$; $\eta p2$ ranged between 0.10 and 0.29) improved remarkably, post-treatment, in SSC group in comparison with the control group. Conclusion: The evidence from this study suggests that SSC exercises besides standard physical rehabilitation appear to be effective for improving gait symmetry and boosting balance capabilities in children with UCP.

PMID: 34180425

7. Evaluation of Individualized Functional Electrical Stimulation-Induced Acute Changes during Walking: A Case Series in Children with Cerebral Palsy
Nicole Zahradka, Ahad Behboodi, Ashwini Sansare, Samuel C K Lee

Sensors (Basel). 2021 Jun 29;21(13):4452. doi: 10.3390/s21134452.

Functional electrical stimulation (FES) walking interventions have demonstrated improvements to gait parameters; however, studies were often confined to stimulation of one or two muscle groups. Increased options such as number of muscle groups targeted, timing of stimulation delivery, and level of stimulation are needed to address subject-specific gait deviations. We aimed to demonstrate the feasibility of using a FES system with increased stimulation options during walking in children with cerebral palsy (CP). Three physical therapists designed individualized stimulation programs for six children with CP to target participant-specific gait deviations. Stimulation settings (pulse duration and current) were tuned to each participant. Participants donned our custom FES system that utilized gait phase detection to control stimulation to lower extremity muscle groups and walked on a treadmill at a self-selected speed. Motion capture data were collected during walking with and without the individualized stimulation program. Eight gait metrics and associated timing were compared between walking conditions. The prescribed participant-specific stimulation programs induced significant change towards typical gait in at least one metric for each participant with one iteration of FES-walking. FES systems with increased stimulation options have the potential to allow the physical therapist to better target the individual's gait deviations than a one size fits all device.

PMID: 34209917

8. Gait training using a hybrid assistive limb after botulinum toxin treatment for cerebral palsy: a case report
Mayumi Matsuda Kuroda, Hirotaka Mutsuzaki, Kenichi Yoshikawa, Haruka Ohguro, Iwasaki Nobuaki

Case Reports J Phys Ther Sci. 2021 Jun;33(6):499-504. doi: 10.1589/jpts.33.499. Epub 2021 Jun 18.

[Purpose] Hybrid Assistive Limb® (HAL; Cyberdyne, Tsukuba, Japan) is a wearable robot that assists patients based on their voluntary movements. We report gait training with HAL after botulinum toxin treatment for spasticity of the lower limb in cerebral palsy (CP). [Participant and Methods] The participant was a 36 year-old male with spastic diplegia due to periventricular leukomalacia, with Gross Motor Function Classification System (GMFCS) level II. HAL training was performed in 20-minute sessions (3 sessions/week for 4 weeks). The outcome measures were range of motion, spasticity, walking ability, muscle strength, gross motor function measure (GMFM), Canadian Occupational Performance Measure (COPM), and Pediatric Evaluation of Disability Inventory measured before, immediately after, and one, two, and three months after HAL training. [Results] No adverse events were observed during training. After the HAL intervention, gait speed, step length, cadence, 6-min walking distance (6MD), knee extension strength, GMFM, and COPM increased, and Physiological Cost Index declined. Three months post-intervention, gait speed, step length, cadence, 6MD, and GMFM remained higher than those observed within the first two months. [Conclusion] Gait training with HAL can be a safe and feasible method for patients with CP who undergo botulinum toxin treatment to improve walking ability and motor function.

PMID: 34177115

9. Usability and Reliability of the Edinburgh Visual Gait Score in Children with Spastic Cerebral Palsy Using Smartphone Slow-Motion Video Technology and a Motion Analysis Application: A Pilot Study
Alaric Aroojis, Bhushan Sagade, Suresh Chand

Indian J Orthop. 2021 Jan 13;55(4):931-938. doi: 10.1007/s43465-020-00332-y. eCollection 2021 Aug.

Background: The Edinburgh Visual Gait Score (EVGS) is a comprehensive measure of gait abnormalities in children with cerebral palsy (CP) and has good psychometric properties. However, it is cumbersome to administer and requires multiple devices to record and measure its various components. We conducted this study to determine if a smartphone video protocol could be used to improve the usability and reliability of the EVGS for daily use in a clinic setting. Methods: We used a handheld smartphone camera with slow-motion video technology and a motion analysis application to record and measure the EVGS of 30 ambulatory children with spastic CP. We tested the inter- and intra-rater reliability of various components of the EVGS between two observers. Results: Average age was 7 years 3 months (range 4-14 years). The mean (range) EVGS scores for the trunk, pelvis, hip, knee, ankle, and foot were 1.18 (0-3), 0.68 (0-3), 1.1 (0-4), 3.95 (1.5-7.5), 1.87 (0-4) and 4.13 (2-6.5) respectively. Total score was 12.92 (7-21.5). The mean (SD) scores for Gross Motor Function Classification System (GMFCS) levels II and III were 10.73 (3.86) and 14.96 (4.2) ($p < 0.001$). The intra-observer and inter-observer reliability using percentage of complete agreement was 65-98.3% and 61.7-92.5% respectively, with kappa values ranging from 0.15 to 0.87. Reliability was more for distal limb segments as compared to proximal segments. Conclusion: We have described a simple and reliable method for quantitative OGA of children with CP, using smartphone video technology and motion analysis application,

which can be performed by every clinician in an office setting.

PMID: 34194650

10. Percutaneous Endoscopic Gastrostomy Feeding in Children with Cerebral Palsy
Hasret Ayyildiz Civan, Gonca Bektas, Ali Evrim Dogan, Fatih Ozdener

Neuropediatrics. 2021 Jun 30. doi: 10.1055/s-0041-1731007. Online ahead of print.

Aim: The prevalence of congenital cerebral palsy (CP) worldwide ranges from 0.15 to 0.4%. CP causes several gastrointestinal complications that inhibit normal eating behavior. This single-center observational study aimed to determine the tolerability and benefits of percutaneous endoscopic gastrostomy (PEG) in pediatric CP patients with malnutrition. Materials and methods: The study included 41 pediatric CP patients with malnutrition. All patient data were retrospectively obtained from Bakırköy Dr. Sadi Konuk Research and Training Hospital, Department of Pediatric Gastroenterology, Hepatology, and Nutrition, Istanbul, Turkey. In addition to baseline measurements of weight, height, triceps skinfold thickness, 1,25-hydroxyvitamin D3, folate, iron, zinc, vitamin B12, hemoglobin, and mean corpuscular volume, data analyzed included follow-up measurements recorded at 3 and 6 months of PEG (standard polymeric enteral supplementation as 1.0 kcal mL-1). Results: There was significant improvement in both height, weight, and triceps skinfold thickness in all patients at 3 and 6 months of PEG ($p < 0.05$). In terms of blood parameters, there was not significant improvement, except that the number of patients with a low hemoglobin count significantly decreased at 3 and 6 months of ($p = 0.022$). Moreover, the number of patients with vomiting after PEG also significantly decreased at 3 and 6 months of ($p = 0.004$). Conclusion: PEG significantly improves malnutrition in pediatric CP patients and does not cause any major complications. Based on these findings, we think PEG is a beneficial and cost-effective intervention with a high rate of tolerability in pediatric CP patients with malnutrition.

PMID: 34192785

11. Experiences before and after nasogastric and gastrostomy tube insertion with emphasis on mealtimes: a case study of an adolescent with cerebral palsy
Ulrika Mårtensson, Mats Cederlund, Margaretha Jenholt Nolbris, Karin Mellgren, Helle Wijk, Stefan Nilsson

Int J Qual Stud Health Well-being. 2021 Dec;16(1):1942415. doi: 10.1080/17482631.2021.1942415.

Purpose: Adolescents with cerebral palsy may need a feeding tube due to feeding challenges, since nutritional intake and mealtimes may be negatively affected. The purpose of the study was to describe and better understand how one adolescent with cerebral palsy and her parents experienced mealtimes before and after a nasogastric and gastrostomy tube insertion and how the use of these feeding tubes was experienced in daily life. Methods: Individual interviews were performed with one adolescent and each of her parents. In total, six interviews were conducted on two separate occasions. The qualitative approach known as Interpretive Description was used during the analysis. Results: Four thematic patterns were identified within the data: (i) struggling with nutritional intake, (ii) the paradox of using an aid, (iii) being different, and (iv) challenges of public mealtimes .Conclusions: The results showed that four themes influenced daily mealtimes in adolescents with cerebral palsy and a gastrostomy tube. Nutritional intake and mealtimes may be difficult, which is why using a gastrostomy tube can be a relief. However, the gastrostomy tube can also pose a challenge and a paradox. Time of change and acceptance seems necessary in order to meet these challenges.

PMID: 34167445

12. The Effects of Neurodevelopmental Therapy on Feeding and Swallowing Activities in Children with Cerebral Palsy
Gönül Acar, Nasim Ejraei, Dilşad Turkdoğan, Necati Enver, Gülten Öztürk, Gülçin Aktaş

Dysphagia. 2021 Jun 25. doi: 10.1007/s00455-021-10329-w. Online ahead of print.

This study investigated the effect of the structured Neurodevelopmental Therapy Method-Bobath (NDT-B) approach on the

feeding and swallowing activity of patients with cerebral palsy (CP) and feeding difficulties. In addition to feeding and oral motor intervention strategies (OMIS), and nutrition-related caregiver training (NRCT), and the NDT-B, which was structured to increase trunk and postural control, was added to the therapy program. Forty patients with CP, with a mean age of 3.25 ± 0.927 years, were classified using the Gross Motor Function Classification System, Eating and Drinking Ability Classification System, and Mini-Manual Ability Classification System. The patients were randomly assigned into two groups as OMIS + NRCT (n = 20) and OMIS + NRCT + NDT-B (n = 20). The program was applied for 6 weeks, 2 days/week, for 45 min. The patients were evaluated using the Trunk Impairment Scale, Schedule for Oral Motor Assessment, and the Pediatric Quality of Life Inventory before and after 6 weeks. The trunk control of the OMIS + NRCT + NDT-B group was superior to the other group (P = 0.026). Although there was an improvement in the groups according to the subcategories of SOMA, the OMIS + NRCT + NDT-B group was superior in the trainer cup and puree subcategories of SOMA (P = 0.05). A significant correlation was observed between trunk control and oral motor functions in children with CP, and the eating function of children in the OMIS + NRCT + NDT-B group further improved. NDT-B-based neck and trunk stabilization exercises should be added to the treatment programs.Trial Registration NCT04403113.

PMID: 34173063

13. Caries prevalence using ICDAS visual criteria and risk assessment in children and adolescents with cerebral palsy: A comparative study

Camila Menezes Costa Castelo Branco, Gloria Maria Pimenta Cabral, Alix Maria Gregory Sawaya Castro, Ana Cristina Fernandes Maria Ferreira, Carlos Felipe Bonacina, Adrian Lussi, Maria Teresa Botti Rodrigues Santos, Michele Baffi Diniz

Spec Care Dentist. 2021 Jun 25. doi: 10.1111/scd.12621. Online ahead of print.

Aims: To compare the dental caries prevalence using the International Caries Detection and Assessment System (ICDAS) and the caries risk by Caries Management by Risk Assessment (CAMBRA) in individuals with cerebral palsy (CP) and normoactives (NAs). Methods and results: Sixty children and adolescents aged 6-12 years (30 CP/30 NA) were clinically evaluated by one calibrated examiner using two-digit ICDAS criteria and converted into components of dmf/DMF indices: d2mf2/D2MF2 (enamel and dentin lesions) and d3mf3/D3MF3 (dentin lesions). An adapted CAMBRA was used for risk classification. The mean d2mf2s/d2mf2t and D2MF2S/D2MF2T for CP were 17.0 ± 16.8/7.5 ± 4.3 and 10.7 ± 17.6/5.3 ± 5.8, respectively, and for NA were 17.2 ± 16.9 /6.9 ± 4.8 and 11.1 ± 11.7/5.5 ± 4.7, respectively. The mean d3mf3s/d3mf3t and D3MF3S/D3MF3T for CP were 10.1 ± 16.7/3.0 ± 4.1 and 4.9 ± 15.6/0.2 ± 0.4, respectively, while for NA the mean values were 9.8 ± 13.0/3.5 ± 3.8 and 2.1 ± 5.7/0.9 ± 2.0, respectively. There were no statistically differences for caries prevalence and risk in both groups ($p > 0.05$). Conclusions: Dental caries was highly prevalent in CP and NA children and adolescents. Enamel and dentin lesions and high caries risk were the most common condition.

PMID: 34171134

14. Exploring the Determinants of Caries Experiences and Nutritional Status among Children with Cerebral Palsy

Ahmad Rathmawati, Abd Rahman Normastura, Hasan Ruhaya

Iran J Public Health. 2021 Mar;50(3):622-623. doi: 10.18502/ijph.v50i3.5628.

PMID: 34178813

15. Situation analysis of rehabilitation services for persons with disabilities in Bangladesh: identifying service gaps and scopes for improvement

Mahmudul Hassan Al Imam, Israt Jahan, Manik Chandra Das, Mohammad Muhit, Delwar Akbar, Nadia Badawi, Gulam Khandaker

Disabil Rehabil. 2021 Jun 27;1-14. doi: 10.1080/09638288.2021.1939799. Online ahead of print.

Purpose: Rehabilitation needs are rising globally; however, the rate is strikingly higher in low- and middle-income countries (LMICs). Like many LMICs, the situation of rehabilitation services for persons with disabilities (PwDs) in Bangladesh is

mostly unknown. We assessed the current situation of rehabilitation services for PwDs in Bangladesh. Materials and methods: This mixed-method study incorporated an online survey of rehabilitation service providers and a scoping review of documents published on rehabilitation services for PwDs in Bangladesh. Descriptive and thematic analyses were completed. Results: A total of 1102 rehabilitation service providers were interviewed, and 36 documents were reviewed. Rehabilitation services for PwDs were found not integrated into the mainstream health services, financing mechanisms, information systems, and health policies in Bangladesh. There are 6.8 rehabilitation units for 1 million people, and 6.2% of them are located in rural areas. In terms of the rehabilitation workforce, there are 9.4 physiotherapists, 1.3 occupational therapists, 0.9 speech and language therapists, and 0.2 prosthetist and orthotists for 1 million people in Bangladesh. Majority (66.3%) of rehabilitation services require an out-of-pocket payment. Conclusions: A critical shortage and uneven distribution of the rehabilitation workforce are evident, indicating a likelihood of very high unmet rehabilitation needs in Bangladesh. To strengthen the rehabilitation capacity of Bangladesh, rehabilitation services should be integrated into mainstream health policies and programs with a special focus on the rehabilitation workforce training, recruitment and distribution, and allocation of resources. Implications for rehabilitation: Rehabilitation services in Bangladesh are mostly provided by the private sector, although the government of Bangladesh operates a small number of rehabilitation services outside of the mainstream public health service delivery system. Rehabilitation services are lacking in the primary and secondary health facilities, while services at tertiary level public hospitals are mainly provided by medical technologists in the absence of a qualified rehabilitation workforce. A severe shortage of rehabilitation workforce coupled with an uneven distribution of the existing limited number of rehabilitation services and out-of-pocket expenditures might result in inadequate access and poor rehabilitation service uptake amongst persons with disabilities (PwDs) in Bangladesh. Robust governance and leadership are needed to monitor the implementation of existing legislations and policies and develop strategies to improve the situation of rehabilitation services for PwDs in Bangladesh.

PMID: 34176400

16. Predictors of Rehabilitation Service Utilisation among Children with Cerebral Palsy (CP) in Low- and Middle-Income Countries (LMIC): Findings from the Global LMIC CP Register
Mahmudul Hassan Al Imam, Israt Jahan, Mohammad Muhit, Denny Hardianto, Francis Laryea, Amir Banjara Chhetri, Hayley Smithers-Sheedy, Sarah McIntyre, Nadia Badawi, Gulam Khandaker

Brain Sci. 2021 Jun 25;11(7):848. doi: 10.3390/brainsci11070848.

Background: We assessed the rehabilitation status and predictors of rehabilitation service utilisation among children with cerebral palsy (CP) in selected low- and middle-income countries (LMICs). Methods: Data from the Global LMIC CP Register (GLM-CPR), a multi-country register of children with CP aged <18 years in selected countries, were used. Descriptive and inferential statistics (e.g., adjusted odds ratios) were reported. Results: Between January 2015 and December 2019, 3441 children were registered from Bangladesh (n = 2852), Indonesia (n = 130), Nepal (n = 182), and Ghana (n = 277). The proportion of children who never received rehabilitation was 49.8% (n = 1411) in Bangladesh, 45.8% (n = 82) in Nepal, 66.2% (n = 86) in Indonesia, and 26.7% (n = 74) in Ghana. The mean (Standard Deviation) age of commencing rehabilitation services was relatively delayed in Nepal (3.9 (3.1) year). Lack of awareness was the most frequently reported reason for not receiving rehabilitation in all four countries. Common predictors of not receiving rehabilitation were older age at assessment (i.e., age of children at the time of the data collection), low parental education and family income, mild functional limitation, and associated impairments (i.e., hearing and/or intellectual impairments). Additionally, gender of the children significantly influenced rehabilitation service utilisation in Bangladesh. Conclusions: Child's age, functional limitation and associated impairments, and parental education and economic status influenced the rehabilitation utilisation among children with CP in LMICs. Policymakers and service providers could use these findings to increase access to rehabilitation and improve equity in rehabilitation service utilisation for better functional outcome of children with CP.

PMID: 34202162

17. Adults with spastic diplegic cerebral palsy living in a low-to-middle income Country: A six-year follow-up study on pain, functional mobility, activity and participation
Jacques du Toit Maaike M Eken, Robert P Lamberts, Nelleke G Langerak

Disabil Health J. 2021 Jun 8;101130. doi: 10.1016/j.dhjo.2021.101130. Online ahead of print.

Background: Insight into the day-to-day challenges faced by adults living with Cerebral Palsy (CP) in low-to-middle income countries (LMICs) will enable support towards healthy ageing in this population. Objectives: To determine changes in level of pain, functional mobility and accomplishment as well as satisfaction in daily life of ambulant adults with CP living in a LMIC

over a six-year period, compared to typically developed (TD) adults. In addition, to determine associations with individual characteristics. Methods: Twenty-eight adults with CP and spastic diplegia (median [interquartile ranges] age = 39.0 [34.0-45.7] years; Gross Motor Function Classification System level I/II/III: n = 11/12/5) participated in this study, together with 28 matched TD adults. Levels of accomplishment and satisfaction were assessed with the Life-Habits questionnaire, functional mobility was determined with the Functional Mobility Scale and (back, lower and upper limb) pain frequency was gauged with a standardized questionnaire. Results: Life-Habits accomplishment and satisfaction scores of adults with CP remained unchanged during the six-year follow-up, with 79% being independent and 100% satisfied. Functional mobility decreased and related to the total accomplishment score. No change in pain frequency was observed, but adults with CP experienced more pain than their peers. Back pain was significantly associated with the total satisfaction score. Conclusions: Relative high levels of accomplishment and satisfaction and no change in pain frequency were noted during a six-year follow-up study of adults with CP living in a LMIC. The importance of exercise/rehabilitation programs to reduce pain and maintain functional mobility in persons ageing with CP was highlighted.

PMID: 34172416

18. Impact of gestational age on risk of cerebral palsy: unravelling the role of neonatal morbidity
Ruoqing Chen, Arvid Sjölander, Stefan Johansson, Donghao Lu, Neda Razaz, Kristina Tedroff, Eduardo Villamor, Sven Cnattingius

Int J Epidemiol. 2021 Jun 28;dyab131. doi: 10.1093/ije/dyab131. Online ahead of print

Background: The contribution of adverse consequences of preterm birth to gestational-age-related risk of cerebral palsy (CP) has rarely been studied. We aimed to assess the potential mediating roles of neonatal morbidity on the association between gestational age and risk of CP. Methods: In this Swedish population-based study, 1 402 240 singletons born at 22-40 gestational weeks during 1998-2016 were followed from day 28 after birth for a CP diagnosis until 2017. Potential mediators included asphyxia, respiratory-related, infection-/inflammatory-related and neurological-related diseases within 0-27 days of life. Cox regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs). Causal mediation analysis was performed to estimate the proportion of the association mediated through pathways involving the four sequential mediators. Results: We found an inverse dose-response relationship between gestational age and risk of CP, where the strongest association was observed for 22-24 weeks (HR 47.26, 95% CI 34.09-65.53) vs 39-40 weeks. Compared with non-diseased peers, children with neonatal morbidity, particularly those with neurological-related diseases (HR 31.34, 95% CI 26.39-37.21), had a higher risk of CP. The increased risk of CP was, at 24 weeks, almost entirely explained by neonatal morbidity (91.7%); this proportion decreased to 46.1% and 16.4% at 32 and 36 weeks, respectively. Asphyxia was the main mediating pathway from 22 to 34 weeks, and neurological-related neonatal diseases led the mediating pathways from 34 weeks onwards. Conclusion: Neonatal morbidity mediates a large proportion of the effect of preterm birth on CP, but the magnitude declines as gestational age increases.

PMID: 34179975

19. Identifying the Critical Threshold for Long-Term Pediatric Neurological Hospitalizations of the Offspring in Preterm Delivery
Shiran Zer, Tamar Wainstock, Eyal Sheiner, Shayna Miodownik, Gali Pariente

J Clin Med. 2021 Jun 29;10(13):2919. doi: 10.3390/jcm10132919.

We opted to investigate whether a critical threshold exists for long-term pediatric neurological morbidity, and cerebral palsy (CP), in preterm delivery, via a population-based cohort analysis. Four study groups were classified according to their gestational age at birth: 24-27.6, 28-31.6, 32-36.6 weeks and term deliveries, evaluating the incidence of long-term hospitalizations of the offspring due to neurological morbidity. Cox proportional hazard models were performed to control for confounders. A Kaplan-Meier survival curve was used to compare the cumulative neurological morbidity incidence for each group. A total of 220,563 deliveries were included: 0.1% (118) occurred at 24-27.6 weeks of gestation, 0.4% (776) occurred at 28-31.6 weeks of gestation, 6% (13,308) occurred at 32-36.6 weeks of gestation and 93% (206,361) at term. In a Cox model, while adjusting for confounders, delivery before 25 weeks had a 3.9-fold risk for long-term neurological morbidity (adjusted HR (hazard ratio) = 3.9, 95% CI (confidence interval) 2.3-6.6; p < 0.001). The Kaplan-Meier survival curve demonstrated a linear association between long-term neurological morbidity and decreasing gestational age. In a second Cox model, adjusted for confounders, infants born before 25 weeks of gestation had increased rates of CP (adjusted HR = 62.495% CI 25.6-152.4; p < 0.001). In our population, the critical cut-off for long-term neurological complications is delivery before 25 weeks

gestation.

PMID: 34209950

20. The role of early-onset-sepsis in the neurodevelopment of very low birth weight infants
Tjark Ortgies, Michael Rullmann, Dorothée Ziegelhöfer, Annett Bläser, Ulrich H Thome

BMC Pediatr.2021 Jun 25;21(1):289. doi: 10.1186/s12887-021-02738-5.

Aims: The study investigated a putative association between early-onset-sepsis (EOS) and poor neurodevelopmental outcomes at 2 years corrected age in very low birth weight infants. Methods: This was a single-center cohort study on infants weighing less than 1500 g with a gestational age below 35 weeks at birth born between 2008 and 2011. Neurodevelopmental outcomes were assessed at follow-up with the Bayley Scales of Infant Development-II. EOS was defined as either culture-proven EOS or clinical EOS using blood culture, CrP levels, and clinical symptoms and treatment. Neurodevelopmental impairment (NDI) was defined as one or more of the following: Mental Developmental Index (MDI) and/or Psychomotor Developmental Index (PDI) scores lower than 70; presence of cerebral palsy. Results: Of 405 eligible newborns in the study period 166 were included. Two had culture-proven and 29 clinical EOS. Median MDI scores in patients with EOS were 96 (IQR: 86-106) and in the control group 94 (84-106, p = 0.77). PDI scores in patients with EOS were 96 (86-106) and in the control group 99,5 (92-103, p = 0.03). Of infected patients 7/31 (24%) showed NDI as defined, whereas only 11/135 (8%) showed NDI in the control group (OR 3.3, p = 0.03). Multiple regression analyses identified chorioamnionitis and poor CRIB-Scores as individual risk factors for MDI or PDI values < 70. Conclusion: In our study, EOS among VLBW-infants significantly impaired the neurodevelopment at 2 years corrected age. As shown in previous reports infection continues to be a problem and strategies for a reduction need further improvement.

PMID: 34172028

21. Low birth weight as a predictor of adverse health outcomes during adulthood in twins: a systematic review and meta-analysis
Sapha Hassan, Shayesteh Jahanfar, Joseph Inungu, Jeffrey M Craig

Review Syst Rev. 2021 Jun 24;10(1):186. doi: 10.1186/s13643-021-01730-5.

Background: Low birth weight might affect adverse health outcomes during a lifetime. Our study analyzes the association between low birth weight and negative health outcomes during adulthood in twin populations. Methods: Searches were conducted using databases inclusive of MEDLINE, CINAHL, Web of Science, and EBSCO. Observational studies on twins with low birth weight and adverse health outcomes during adulthood were included. Two reviewers independently screened the papers, and a third reviewer resolved the conflicts between the two reviewers. Following abstract and title screening, full-texts were screened to obtain eligibility. Eligible full-text articles were then assessed for quality using a modified Downs and Black checklist. Studies with a score within one standard deviation of the mean were included in the analysis. A fixed-effect model was used for analysis. Results: 3987 studies were screened describing low birth weight as a risk factor for adverse health outcomes during adulthood for all twelve-body systems (circulatory, digestive, endocrine, lymphatic, muscular, nervous, reproductive, respiratory, skeletal, urinary, and integumentary systems). One hundred fourteen articles made it through full-text screening, and 14 of those articles were assessed for quality. Five papers were selected to perform two meta-analyses for two outcomes: asthma and cerebral palsy. For asthma, the meta-analyses of three studies suggested a higher odds of low birth weight twins developing asthma (OR 1.33, 95% CI 1.24-1.44, I2 = 77%). Meta-analysis for cerebral palsy included two studies and suggested a 4.88 times higher odds of low birth weight twins developing cerebral palsy compared to normal birth weight twins (OR 4.88, 95% CI 2.34-10.19, I2 = 79%). We could not find enough studies for other adverse health outcomes to pool data for a Forest plot. Conclusions: The odds of low birth weight were found to be high in both asthma and cerebral palsy. There are not enough studies of similar nature (study types, similar body systems) to ensure a meaningful meta-analysis. We recommend that future research considers following up on twins to obtain data about adverse health outcomes during their adult lives.

PMID: 34167585

22. Neurodevelopmental impairment is associated with altered white matter development in a cohort of school-aged children born very preterm
Eleanor Kennedy, Tanya Poppe, Anna Tottman, Jane Harding

Neuroimage Clin. 2021 Jun 17;31:102730. doi: 10.1016/j.nicl.2021.102730. Online ahead of print.

Individuals born very preterm (<32 weeks gestation) have altered brain growth and white matter maturation relative to their full-term peers, and approximately 30% will experience neurodevelopmental impairment. We investigated the relationship between neurodevelopmental impairment and MRI measures of white matter microstructure and brain volume. Children born before 30 weeks' gestation or who had very low birthweight (< 1500 g) underwent neurodevelopmental assessment and MRI at age 7 years as part of the PIANO study, a New Zealand-based cohort study. Fractional anisotropy (FA) and diffusivity measures were derived from diffusion tensor imaging to index white matter microstructure. Volumes were derived from T1-weighted imaging. Neurodevelopmental impairment was defined as a score < 85 on the Wechsler Intelligence Scale for Children, <5th centile on the Movement Assessment Battery for Children or a diagnosis of cerebral palsy by a paediatrician. Relationships between MRI and neurodevelopmental impairment were assessed with general linear models adjusted for sex, gestational age at birth, birthweight z-score, age at assessment, New Zealand Deprivation index score and multiplicity. Children with neurodevelopmental impairment (n = 38) had smaller total brain, cortical grey matter and cerebral white matter volumes compared to children without neurodevelopmental impairment (n = 62) ($p < 0.05$, false discovery rate corrected), but the regional volume differences did not remain significant after adjustment for total brain volume. Lower FA and higher radial diffusivity were observed in the superior longitudinal fasciculi, uncinate fasciculi and right hemisphere corticospinal tract in children with neurodevelopmental impairment. This may reflect differences in cellular properties such as myelination or axonal packing. Neurodevelopmental impairment may reflect smaller overall brain volume and altered microstructure in white matter tracts that are important for language, cognitive and motor functioning.

PMID: 34174689

23. Early access to physiotherapy for infants with cerebral palsy: A retrospective chart review
Linnéa Hekne, Cecilia Montgomery, Kine Johansen

PLoS One. 2021 Jun 25;16(6):e0253846. doi: 10.1371/journal.pone.0253846. eCollection 2021.

Aim: This study aimed to investigate whether children with cerebral palsy (CP) had equal access to timely physiotherapy. Additionally, to learn more about clinical characteristics of infants with CP, we explored differences in neonatal clinical history and CP profile between children referred by a neonatologist or enrolled in neonatal follow-up and those referred by other healthcare professionals as well as those referred before and after 5 months corrected age. Methods: We conducted a retrospective chart review study including children born in Uppsala County, Sweden, from 2010 to 2016, who had received a CP diagnosis by July 2019. Entries by doctors and physiotherapists working at Uppsala University Children's Hospital were reviewed. Results: Thirty-eight children were included (21 girls, 55.3%) in the study. Twenty-two (57.9%) were born at term. Twenty-five children (66%) had their first visit to a physiotherapist before 5 months corrected age, and this included all children (n = 22, 57.9%) referred by a neonatologist or enrolled in neonatal follow-up. The latter group had significantly earlier access to physiotherapy compared to children referred by other healthcare professionals, with a median of 1.9 (min-max: -1-4) and 7.6 (min-max: 1-24) months, respectively ($p < 0.0001$). Referral source explained unique variance in predicting time of referral to physiotherapist (R2 0.550, B 4.213, $p < 0.0001$) when controlling for both number of risk factors and severity of motor impairment. However, number of risk factor was vital for early access to physiotherapy for children referred by other health care professionals. Children referred by a neonatologist or enrolled in neonatal follow-up or referred before 5 months corrected age differed on all measured variables concerning neonatal clinical history and CP profile, compared to children referred by other healthcare professionals or after 5 months corrected age. The latter groups had milder forms of CP. In total, twenty-eight children (73.7%) were ambulatory at 2 years of age. Bilateral spastic CP was most common among those referred by a neonatologist or enrolled in neonatal follow-up or referred before 5 months corrected age, while unilateral spastic CP was most common among those referred by other healthcare professionals or after 5 months corrected age. Conclusion: Infants with CP have unequal access to timely physiotherapy, and children considered at low risk for CP receive therapy later. Neonatal follow-up of infants considered at high risk for CP that involves an assessment of motor performance using an evidence-based method during the first months of life corrected age seems to be effective in identifying CP early. Conversely, measuring milestone attainment seems to be a less reliable method for early identification. To provide safe and equal care, all professionals performing developmental surveillance should receive proper training and use evidence-based assessment methods. Physiotherapy should be available prior to formal medical diagnosis.

PMID: 34170965

24. Standardized Outcomes Measures in Physical Therapy Practice for Treatment and Rehabilitation of Cerebral Palsy: A Systematic Review
Maria Dolores Apolo-Arenas, Aline Ferreira de Araújo Jerônimo, Alejandro Caña-Pino, Orlando Fernandes, Joana Alegrete, Jose Alberto Parraca

Review J Pers Med. 2021 Jun 26;11(7):604. doi: 10.3390/jpm11070604.

Cerebral palsy (CP) treatment includes physical therapy and various complementary therapies to the standard clinical treatment. However, there are not many reviews that focus on the methods used and evaluation procedures. This study aims to analyze which tools are most suitable for the evaluation and methodology of patients with CP treated with physical therapy. Following the PRISMA statement, through a PICOS strategy, PubMed/MEDLINE, Web of Science (WOS), Scopus, Science Direct, and Scielo were searched with the following terms: cerebral palsy AND (physical therapy modalities OR therapeutics) AND outcome assessment. The methodological quality of the RCTs was assessed with the Evidence Project risk of bias tool. Thirty-seven RCTs and six RCT protocols, comprising 1359 participants with different types of CP: spastic hemiplegia/paresis, spastic diplegia/paresis, and spastic CP, met the inclusion criteria, uncovering 21 variables measured through 77 different instruments and several interventions. The therapies most widely used in CP are gaming or technology-assisted therapies, aerobic training, hippotherapy, music therapy, gait training, and aquatic exercises. This study provides an overview of what the authors used in the neurorehabilitation field through procedure evaluation and checking the technological advance that began to be used.

PMID: 34206816

25. Role and Effects of Hippotherapy in the Treatment of Children with Cerebral Palsy: A Systematic Review of the Literature
María José Menor-Rodríguez, Mar Sevilla Martín, Juan Carlos Sánchez-García, María Montiel-Troya, Jonathan Cortés-Martín, Raquel Rodríguez-Blanque

Review J Clin Med. 2021 Jun 11;10(12):2589. doi: 10.3390/jcm10122589.

Cerebral palsy is described as a group of permanent neuromotor-type disorders caused by non-progressive injuries in the developmental stages of the central nervous system, and which have serious repercussions on the quality of life of affected children due to the physical and psychological damage it entails for them. Today, it is the leading cause of physical disability in childhood. Since there is no cure for this disorder, treatment is based on the improvement of symptoms, which is not always achieved through conventional therapies. For this reason, the need arises to investigate other alternative therapies, such as hippotherapy, to determine the main effects of hippotherapy as a rehabilitation therapy in children with cerebral palsy. The review was performed in accordance with the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol and was registered under the number CRD42021233003. The databases used were PubMed, Dialnet and the web browser Google Scholar. After applying the inclusion criteria, we included 11 articles. As a conclusion, we found that hippotherapy provides benefits at physical, psychological, cognitive and social levels in children with cerebral palsy, and thus it should be considered as a complementary rehabilitation therapy to conventional treatments.

PMID: 34208206

26. Factors Affecting Participation of Children with Cerebral Palsy in Meaningful Activities: Systematic Review
Marzieh Pashmdarfard, Lorie Gage Richards, Malek Amini

Occup Ther Health Care. 2021 Jun 30;1-38. doi: 10.1080/07380577.2021.1938339. Online ahead of print.

This is a systematic review using PRISMA guidelines to review the factors affecting participation of children with cerebral palsy (CP), the most common childhood motor disability. Inclusion criteria consisted of publications in a peer-reviewed journal between 2000 and 2018, and at I, II, III, and IV levels of AOTA Evidence. After the title, abstract, and a full text screening, 31 articles met eligibility to be included. The studies examined ADLs (12), IADLs (9), play and leisure (19), and social participation (14), but only 3 in rest/sleep, 1 in work, and 8 in education. Gross motor and manual function, CP type, home, and

community physical environment, were the most common factors affecting individuals' participation with CP. Results imply occupational therapists must evaluate clients on all factors shown to facilitate or inhibit participation to ensure an adequate intervention plan. However, evaluating every individual case in the occupational therapy process is time-consuming and difficult. Based on this study's findings, we suggest occupational therapists prioritize evaluating motor skills (gross and fine), the most influential of the factors in all areas of participation. Occupational therapists also could advocate for policy around community environmental barrier removal.

PMID: 34191669

27. Neuromuscular Electrical Stimulation Improves Muscle Strength, Biomechanics of Movement, and Functional Mobility in Children with Chronic Neurological Disorders: A Systematic Review and Meta-Analysis
Fernando Cobo-Vicente, Alejandro F San Juan, Eneko Larumbe-Zabala, Augustin Jesús Estévez-González, Márcio V F Donadio, Margarita Pérez-Ruiz

Phys Ther. 2021 Jun 28;pzab170. doi: 10.1093/ptj/pzab170. Online ahead of print.

Objective: Chronic neurological disorders (CND) generally produce deleterious effects on the musculoskeletal system and can affect physical activity and increase sedentary behavior in children, hindering the execution of training programs and the attainment of a correct dose of exercise. The purpose of this systematic review is to analyze the effect of NMES on skeletal muscle and then on biomechanics of movement, functional mobility, strength, spasticity, muscle architecture, and body composition of children and adolescents with CND and chronic diseases. Methods: The search was conducted in April 2020 on PubMed, MEDLINE, Scopus, the Cochrane Library, and Web of Science, without publication period restriction. Publications investigating the effect of NMES on children and adolescents with CND and other chronic diseases were independently selected by 2 researchers. One author independently extracted data from the studies selected, and a second author cross-checked. Eighteen studies with 595 participants aged between 3 and 14 years were included. Quality assessment showed that 50% of the studies presented a low risk of bias. The pooled effect of NMES on gross motor functional measure (GMFM), calculated as a standardized mean difference (SMD) using a random effects model, was 0.41 (95% CI = 0.19 to 0.64). Conclusion: The use of NMES programs for children diagnosed with cerebral palsy, spinal muscular atrophy, and obstetric injury of the brachial plexus were effective in improving muscle strength, biomechanics of movement, and functional mobility. Impact: Neuromuscular electrical stimulation (NMES) can be a useful tool to prevent the reduction of mobility that results from CND.

PMID: 34184031

28. Effects of Dog-Assisted Education on Physical and Communicative Skills in Children with Severe and Multiple Disabilities: A Pilot Study
Luis Lucio Lobato Rincón, Beatriz Rivera Martín, María Ángeles Medina Sánchez, Santos Villafaina, Eugenio Merellano-Navarro, Daniel Collado-Mateo

Animals (Basel). 2021 Jun 10;11(6):1741. doi: 10.3390/ani11061741.

Animal-assisted interventions have shown promising benefits in different populations such as children with cerebral palsy or autism spectrum disorder. Human-animal interaction leads to different physical, cognitive, and emotional benefits in the child. The aim of the current pilot study was to evaluate the effects of a dog-assisted education program on the postural, oculomotor, linguistic and autonomy dimensions in children affected by severe and multiple disabilities. Fourteen children aged 3-12 years and affected by intellectual and physical disabilities participated in a dog-assisted program consisted of 12 sessions. The intervention involved different types of activities, exercises, and games with the dogs. A strict protocol to ensure animal wellbeing and avoid any type of stress or fatigue was followed. Children who participated in the study improved their postural control, eye-motor coordination, expression of sensations and feelings, spontaneous interaction, autonomy, and confidence. However, these results must be taken with caution due to the lack of a control group and the heterogeneity of the participants.

PMID: 34200895

29. Decline in Motor Function during the COVID-19 Pandemic Restrictions and Its Recovery in a Child with Cerebral Palsy: A Case Report
Daiki Asano, Naoko Kikuchi, Toru Yamakawa, Shu Morioka

Case Reports Children (Basel). 2021 Jun 17;8(6):511. doi: 10.3390/children8060511.

Children with cerebral palsy (CP) experience various restrictions owing to their underdeveloped mobility. Home confinement due to the coronavirus disease 2019 pandemic may further increase these restrictions. We report the case of a 7-year-old boy with CP (Gross Motor Function Classification System level IV) whose motor function declined during the period when physical therapy was discontinued due to lockdown, approximately four months. At the end of the home confinement, the patient's ability to maintain a sitting posture and weight-bearing capacity of the lower extremities decreased. His Gross Motor Function Measure total score also decreased from 34.5% to 31.9%. After resuming physical therapy, the patient recovered the function status seen before the discontinuation of physical therapy, but this took almost twice as long as the confinement period. We reaffirm that frequent physical therapy is crucial for maintaining motor function in non-ambulatory children with CP. As a countermeasure for the future, urgent efforts are needed for the development of telerehabilitation.

PMID: 34204239

30. Reduced mitochondrial DNA and OXPHOS protein content in skeletal muscle of children with cerebral palsy
Ferdinand von Walden, Ivan J Vechetti Jr, Davis Englund, Vandré C Figueiredo, Rodrigo Fernandez-Gonzalo, Kevin Murach, Jessica Pingel, John J Mccarthy, Per Stål, Eva Pontén

Dev Med Child Neurol. 2021 Jun 27. doi: 10.1111/dmcn.14964. Online ahead of print.

Aim: To provide a detailed gene and protein expression analysis related to mitochondrial biogenesis and assess mitochondrial content in skeletal muscle of children with cerebral palsy (CP). Method: Biceps brachii muscle samples were collected from 19 children with CP (mean [SD] age 15y 4mo [2y 6mo], range 9-18y, 16 males, three females) and 10 typically developing comparison children (mean [SD] age 15y [4y], range 7-21y, eight males, two females). Gene expression (quantitative reverse transcription polymerase chain reaction [PCR]), mitochondrial DNA (mtDNA) to genomic DNA ratio (quantitative PCR), and protein abundance (western blotting) were analyzed. Microarray data sets (CP/aging/bed rest) were analyzed with a focused query investigating metabolism- and mitochondria-related gene networks. Results: The mtDNA to genomic DNA ratio was lower in the children with CP compared to the typically developing group (-23%, $p=0.002$). Out of five investigated complexes in the mitochondrial respiratory chain, we observed lower protein levels of all complexes (I, III, IV, V, -20% to -37%; $p<0.05$) except complex II. Total peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC1α) messenger RNA ($p<0.004$), isoforms PGC1α1 ($p=0.05$), and PGC1α4 ($p<0.001$) were reduced in CP. Transcriptional similarities were observed between CP, aging, and 90 days' bed rest. Interpretation: Mitochondrial biogenesis, mtDNA, and oxidative phosphorylation protein content are reduced in CP muscle compared with typically developing muscle. Transcriptional pathways shared between aging and long-term unloading suggests metabolic dysregulation in CP, which may guide therapeutic strategies for combatting CP muscle pathology.

PMID: 34176131

31. Determinants of participation and quality of life of young adults with cerebral palsy: longitudinal approach and comparison with the general population - SPARCLE 3 study protocol
Catherine Arnaud, Carine Duffaut, Jérôme Fauconnier, Silke Schmidt, Kate Himmelmann, Marco Marcelli, Lindsay Pennington, Joaquim Alvarelhão, Chirine Cytera, Marion Rapp, Virginie Ehlinger, Ute Thyen

BMC Neurol. 2021 Jun 30;21(1):254. doi: 10.1186/s12883-021-02263-z.

Background: Effective inclusion in society for young people with disabilities is increasingly seen as generating opportunities for self-development, and improving well-being. However, significant barriers remain in the vast majority of activities meaningful for young adults. Research argues that various personal (disabilities, health) and environmental (access to the resources needed, accessible environment, discrimination, lack of personal economic independence) factors contribute to limited participation. However, previous studies conducted in young people with cerebral palsy (CP) mainly investigated the transition period to adulthood, and did not fully consider the whole range of impairment severity profiles or environmental

barriers. In this study, we will use the follow-up of the SPARCLE cohort and a comparison group from the general population (1) to investigate the impact of the environment on participation and quality of life of young adults with CP, (2) to determine predictors of a successful young adulthood in educational, professional, health and social fields, (3) to compare quality of life and frequency of participation in social, work and recreational activities with the general population, (4) to document on participation and quality of life in those with severe disabilities. Methods: The SPARCLE3 study has a combined longitudinal and cross-sectional design. Young adults with CP aged 22 to 27 years in 6 European regions previously enrolled in the SPARCLE cohort or newly recruited will be invited to self-complete a comprehensive set of questionnaires exploring participation (daily life and discretionary activities), health-related quality of life, body function, personal factors (health, personal resources), and contextual factors (availability of needed environmental items, family environment, services provision) during home visits supervised by trained researchers. Proxy-reports or adapted questionnaires will be used for those with the most severe impairments. The recruitment of a large group from the general population (online survey) will enable to identify life areas where the discrepancies between young people with CP and their able-bodied peers are the most significant. Discussion: This study will help identify to what extent disabilities and barriers in environment negatively affect participation and quality of life, and how previous valued experiences during childhood or adolescence might modulate these effects.

PMID: 34193065

32. Health Parameters in Standing and Nonstanding Nonambulatory Adults With Cerebral Palsy
Kevin P Murphy, Laura Gueron, Catherine McMillin, Kim B Marben

Arch Rehabil Res Clin Transl. 2021 Feb 16;3(2):100110. doi: 10.1016/j.arrct.2021.100110. eCollection 2021 Jun.

Objective: To assess effects of standing exercise on adults with cerebral palsy with a focus on bone density, transfer skills, quality of life, and related health parameters. Design: Prospective case series; pilot study. Setting: Outpatient multispecialty clinic. Participants: Nonambulatory adults with cerebral palsy, 13 standers and 7 nonstanders, comparable in age, sex, and other physical characteristics (N=20). Interventions: Not applicable. Main outcome measures: Bone mineral density per dual energy x-ray absorptiometry, stand pivot transfers, comprehensive blood serum assessments, fractures, spasms, perceived pain, and quality of life. Results: No appreciable differences could be detected between the standing and nonstanding groups from baseline and over a 2-year subsequent study with respect to bone density, range of motion, comprehensive chemistry, hematologic blood serum levels, fractures, spasms, perceived pain, continence of bowel and bladder, seizures, orthotics, and orthopedic surgery. All individuals reported positive life effects of standing with only 1 negative effect reported: increased fatigue at the end of the day. Midline independent head control >30 seconds was identified only in the standing group. Functional stand pivot transfers were seen only in individuals with a history of standing. Conclusions: The pilot data indicate no appreciable difference in measured outcome variables of a static nature between nonambulatory adults with cerebral palsy who stand compared with those who do not. We identified occurrences of improved head control and functional stand pivot transfers only in those with a history of standing. The value of a functional pivot transfer over the lifetime is difficult to overestimate. Encouragement is given toward future studies with a focus more toward functional outcome variables.

PMID: 34179748

33. Mimicking partial to total placental insufficiency in a rabbit model of cerebral palsy
Zhongjie Shi, Kehuan Luo, Sanket Jani, Melissa February, Nithi Fernandes, Neha Venkatesh, Nadiya Sharif, Sidhartha Tan

J Neurosci Res. 2021 Jun 25. doi: 10.1002/jnr.24901. Online ahead of print.

All placental abruptions begin as partial abruptions, which sometimes manifest as fetal bradycardia. The progression from partial to total abruption was mimicked by a new rabbit model of placental insufficiency, and we compared it, with sufficient statistical power, with the previous model mimicking total placental abruption. The previous model uses total uterine ischemia at E22 or E25 (70% or 79% term, respectively), in pregnant New Zealand white rabbits for 40 min (Full H-I). The new model, Partial+Full H-I, added a 30-min partial ischemia before the 40-min total ischemia. Fetuses were delivered either at E31.5 (full term) vaginally for neurobehavior testing, or by C-section at E25 for ex vivo brain cell viability evaluation. The onset of fetal bradycardia was within the first 2 min of either H-I protocol. There was no difference between Full H-I (n = 442 for E22, 312 for E25) and Partial+Full H-I (n = 154 and 80) groups in death or severely affected kits at E22 (76% vs. 79%) or at E25 (66% vs. 64%), or normal kits at E22 or E25, or any of the individual newborn neurobehavioral tests at any age. No sex differences were found. Partial+Full H-I (n = 6) showed less cell viability than Full H-I (n = 8) at 72-hr ex vivo in the brain regions studied. Partial+Full H-I insult produced similar cerebral palsy phenotype as our previous Full H-I model in a sufficiently powered study and may be more suitable for testing of potential neuroprotectants.

PMID: 34173261

34. How Can Biomechanics Improve Physical Preparation and Performance in Paralympic Athletes? A Narrative Review
Jared R Fletcher, Tessa Gallinger, Francois Prince

Review Sports (Basel) 2021 Jun 24;9(7):89. doi: 10.3390/sports9070089.

Recent research in Paralympic biomechanics has offered opportunities for coaches, athletes, and sports practitioners to optimize training and performance, and recent systematic reviews have served to summarize the state of the evidence connecting biomechanics to Paralympic performance. This narrative review serves to provide a comprehensive and critical evaluation of the evidence related to biomechanics and Paralympic performance published since 2016. The main themes within this review focus on sport-specific body posture: the standing, sitting, and horizontal positions of current summer Paralympic sports. For standing sports, sprint and jump mechanics were assessed in athletes with cerebral palsy and in lower-limb amputee athletes using running-specific prostheses. Our findings suggest that running and jumping-specific prostheses should be 'tuned' to each athlete depending on specific event demands to optimize performance. Standing sports were also inclusive to athletes with visual impairments. Sitting sports comprise of athletes performing on a bike, in a wheelchair (WC), or in a boat. WC configuration is deemed an important consideration for injury prevention, mobility, and performance. Other sitting sports like hand-cycling, rowing, and canoeing/kayaking should focus on specific sitting positions (e.g., arm-crank position, grip, or seat configuration) and ways to reduce aero/hydrodynamic drag. Para-swimming practitioners should consider athlete-specific impairments, including asymmetrical anthropometrics, on the swim-start and free-swim velocities, with special considerations for drag factors. Taken together, we provide practitioners working in Paralympic sport with specific considerations on disability and event-specific training modalities and equipment configurations to optimize performance from a biomechanical perspective.

PMID: 34202455

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