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Cerebral palsy research news

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Interventions and Management

1. The immediate effect of different loads does not alter muscle co-activation of the upper limb in young adults with dyskinetic cerebral palsy
Paulo R G Lucareli, Luciana Barcala, Mariana C Artilheiro, Danielli S Speciali, João C F Correa, Silvio A Garbelotti Junior, Fabiano Politti

Gait Posture. 2021 Aug 27;90:161-166. doi: 10.1016/j.gaitpost.2021.08.018. Online ahead of print.

Background: There is insufficient information on muscle co-activation in the upper limbs to help healthcare providers develop treatment programs for patients with dyskinetic cerebral palsy (DCP). Research question: Is the degree of muscle co-activation greater in adults with DCP than in healthy individuals? Does the use of different arm weights modify co-contraction in individuals with PCD? Methods: Fourteen healthy individuals (control group [CG]) and 14 individuals with DCP (dyskinetic group [DG]) participated in the study. The degree of muscle co-activation of the dominant limb during drinking from a mug was compared between the two groups. The task was divided into a going, adjusting, and returning phase. In the DG, an analysis was also performed on using an arm weight during the functional task. The loads corresponded to 10, 20, and 30 % of maximum isometric muscle strength measured in each participant. Results: In comparing the two groups, the DG exhibited a greater muscle co-activation in the shoulder and elbow muscles during the going phase, the shoulder, elbow, and wrist during the adjusting phase; and the elbow during the returning phase. The DG also showed a greater mean index of curvature (MIC), time to perform the movement phases, and lesser mean velocity (Vm) to drinking. In analyzing the DG's arm weight, no effect on co-activation, MIC, time to perform the movement phases, and Vm to drinking were found with the loads tested ($p > 0.05$). Conclusion: Muscle co-activation is increased in adults with DCP in comparison to healthy individuals. Moreover, arm weight during the functional activity of drinking from a mug did not alter co-activation, although an immediate effect was expected.

PMID: 34482220

2. Factors Affecting Postoperative Complications and Outcomes of Cervical Spondylotic Myelopathy with Cerebral Palsy : A Retrospective Analysis
Hyung Cheol Kim, Hyeongseok Jeon, Yeong Ha Jeong, Sangman Park, Seong Bae An, Jeong Hyun Heo, Dong Ah Shin, Seong Yi, Keung Nyun Kim, Yoon Ha, Sung-Rae Cho

J Korean Neurosurg Soc. 2021 Sep;64(5):808-817. doi: 10.3340/jkns.2021.0012. Epub 2021 Sep 1.

Objective: Cervical surgery in patients with cervical spondylotic myelopathy (CSM) and cerebral palsy (CP) is challenging owing to the complexities of the deformity. We assessed factors affecting postoperative complications and outcomes after CSM surgery in patients with CP. Methods: Thirty-five consecutive patients with CP and CSM who underwent cervical

operations between January 2006 and January 2014 were matched to 35 non-cerebral palsy (NCP) control patients. Postoperative complications and radiologic outcomes were compared between the groups. In the CP group, the Japanese Orthopaedic Association score; Oswestry neck disability index; modified Barthel index; and values for the grip and pinch, Box and Block, and Jebsen-Taylor hand function tests were obtained preand postoperatively and compared between those with and without postoperative complications. Results: Sixteen patients (16/35%) in the CP group and seven (7/35%) in the NCP group (p=0.021) had postoperative complications. Adjacent segment degeneration (p=0.021), postoperative motor weakness (p=0.037), and revisions (p=0.003) were significantly more frequent in the CP group than in the NCP group; however, instrument-related complications were not significantly higher in the CP group (7/35 vs. 5/35, p=0.280). The number of preoperative fixed cervical deformities were significantly higher in CP with postoperative complications (5/16 vs. 1/19, p=0.037). In the CP group, clinical outcomes were almost similar between those with and without postoperative complications. Conclusion: The occurrence of complications during the follow-up period was high in patients with CP. However, postoperative complications did not significantly affect clinical outcomes.

PMID: 34503314

3. More than 25 years after selective dorsal rhizotomy: physical status, quality of life, and levels of anxiety and depression in adults with cerebral palsy
Berendina E Veerbeek, Robert P Lamberts, Elisa Kosel, A Graham Fieggen, Nelleke G Langerak

J Neurosurg. 2021 Sep 10;1-10. doi: 10.3171/2021.3.JNS204096. Online ahead of print.

Objective: The primary purpose of selective dorsal rhizotomy (SDR) is to ameliorate spasticity in the lower extremities of children with cerebral palsy (CP). In correctly selected patients, this neurosurgical procedure has been shown to have a beneficial effect on many aspects of the child's life. However, given the challenges faced by adults with CP, it would be valuable to document the status of this population compared to their peers later in adulthood. Therefore, the aim of this study was to determine the physical status, mental health, and health-related quality of life (HRQoL) of adults with CP who underwent SDR at least 25 years ago, compared to matched typically developing (TD) individuals. The second aim was to investigate relationships between physical status and the other outcome measures. Methods: Adults with CP were recruited from a database of children who had undergone SDR performed using the technique introduced by Professor Warwick Peacock at Red Cross War Memorial Children's Hospital in Cape Town, South Africa, between 1981 and 1991. These individuals were matched for age, sex, body mass index, and socioeconomic status to a TD adult cohort from a similar background. The parameters assessed were lower-extremity muscle tone, passive range of motion, muscle strength, selectivity, functional mobility and dynamic balance (Timed Up and Go [TUG] test), HRQoL (SF-36), and anxiety and depression levels. Results: Twenty-six adults with CP who had a median age of 35.8 years (interquartile range 34.2-41.4 years) (female/male: n = 10/16; Gross Motor Function Classification System level I/II/III: n = 13/10/3), were compared to 26 TD adults. Muscle tone was similar, whereas passive range of motion, muscle strength, selectivity, TUG, and SF-36 physical functioning (concept and summary) scores differed between the cohorts. Other SF-36 parameters, anxiety levels, and depression levels were not different. Strong correlations were found between the muscle strength and TUG scores. Conclusions: Normalized lower-extremity muscle tone was sustained 25-35 years after SDR. Whereas the lower scores for physical assessments are in line with findings in other CP populations, remarkably, relatively good mental health and HRQoL scores were reported in this CP group despite their physical limitations. The strong correlation between muscle strength and TUG suggests that strength training after SDR may have value in improving functional mobility and balance.

PMID: 34507281

4. Relationship between scoliosis, windswept hips and contractures with pain and asymmetries in sitting and supine in 2450 children with cerebral palsy
Jackie Casey, Atli Agustsson, Andreas Rosenblad, Elisabet Rodby-Bousquet

Disabil Rehabil. 2021 Sep 6;1-6. doi: 10.1080/09638288.2021.1971308. Online ahead of print.

Purpose: This cross-sectional study of 2450 children with cerebral palsy aimed to analyse the prevalence and association of scoliosis, windswept hips, hip and knee contractures. Methods: Logistic regression was used to estimate associations with pain, postural asymmetries, and ability to change position for children at Gross Motor Function Classification System (GMFCS) levels I-V, aged 0-18 years. Results: Most children with a deformity or contracture had postural asymmetries in both sitting and supine positions; 10.5% had scoliosis, 8.7% windswept hips, 6.6% hip flexion and 19.2% knee contractures. Severe postural

asymmetries increased the likelihood for scoliosis 9 times, for windswept hips 6 to 9 times, and for hip and knee flexion contractures 7 and 12 times respectively, adjusted for age, sex and GMFCS level. Hip flexion contractures and windswept hips increased the likelihood for pain by 1.5-1.6 times. Conclusion: The likelihood of having scoliosis, windswept hips and flexion contractures in the hips and knees increased if the child had postural asymmetries, and for increased age and higher GMFCS levels. Efforts should focus on preventing postural asymmetries from occurring or progressing, and on increasing the child's ability to change position. Reducing postural asymmetries may also reduce the likelihood of pain. Implications for Rehabilitation: The risk of having scoliosis, windswept hip deformity and flexion contractures in the hips and knees increased if the child had postural asymmetries in sitting or lying. Efforts should focus on preventing or reducing postural asymmetries, and on increasing the child's ability to change position. Reducing postural asymmetries may also reduce the risk of pain.

PMID: 34487468

5. Functional hip joint centre determination in children with cerebral palsy
Orhan Öztürk, Firooz Salami, Arik Rehani Musagara, İlkşan Demirbüken, M Gülden Polat, Sebastian I Wolf, Marco Götze

Gait Posture. 2021 Sep 4;90:185-189. doi: 10.1016/j.gaitpost.2021.08.021. Online ahead of print.

Background: Although functional methods determining the hip joint center (HJC) are becoming increasingly popular, no systematic investigation has been conducted yet to assess the reliability of functional hip joint calibration in patients with cerebral palsy (CP). Research question: What is the most reliable way to conduct functional calibration motions for estimating HJC location in children with CP and movement disorders? Methods: Twenty-two patients with CP were included in the study. A marker set for Plug-in Gait with additional cluster markers was used. Two functional calibration movements, including a new movement, were proposed and tested with one and three repetitions each. Functional HJCs were determined using the SCoRE approach and compared to results obtained by applying the conventional regression method for assessing face validity. Results: The choice of calibration movement had significant impact on SCoRE residuals and HJC location. Increasingly repeating calibration movements did not improve results. A modified star movement by allowing the toes to tip the ground provided the most reliable data and is feasible for children with GMFCS level I-III. The feasibility of the method is further improved by analyzing hip motion in the contralateral stance limb and, among the calibration movements, gave the most precise HJC estimation. Significance: Type and performance of the functional calibration movement is one key factor for determining a robust HJC. Analyzing the data in the stance leg via the modified star motion yielded robust and reasonable results for the HJC location, which should be validated in further studies that include imaging methods. Using one repetition instead of three seems promising in terms of feasibility for patients with movement disorder.

PMID: 34500219

6. Blood Loss and Related Laboratory Changes after Single-Event Multilevel Surgery and Hip Reconstructive Surgery in Patients with Cerebral Palsy
Jae Jung Min, Soon-Sun Kwon, Kyu Tae Kim, Ki Hyuk Sung, Kyoung Min Lee, Young Choi, Moon Seok Park

Clin Orthop Surg. 2021 Sep;13(3):406-414. doi: 10.4055/cios20205. Epub 2021 Jun 3.

Background: Single-event multilevel surgery (SEMLS) and hip reconstructive surgery (HRS) often cause intraoperative bleeding, consequently increasing the probability of transfusion and postoperative laboratory changes. Therefore, it is important to assess risk factors to predict the amount of blood loss. This study aimed to evaluate blood loss, its influencing factors, and the related laboratory changes during SEMLS and HRS in patients with cerebral palsy (CP). Methods: We retrospectively examined consecutive CP patients who underwent SEMLS and HRS. Surrogate markers of blood loss, including preoperative and postoperative hemoglobin (Hb), hematocrit, and changes in Hb concentration, were assessed. Albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and creatine levels were also analyzed for related laboratory changes. Risk factors were analyzed using multiple regression and logistic regression models. Results: The overall cohort comprised 1,188 patients. Of them, 1,007 and 181 underwent SEMLS and HRS, respectively. Furthermore, 72 of 181 patients underwent a concomitant Dega osteotomy. The regression model showed that low preoperative Hb concentration ($p < 0.001$), high albumin level ($p = 0.007$), low body mass index (BMI) ($p = 0.002$), and bilateral HRS ($p < 0.001$) were significant risk factors of postoperative anemia. Valproate medication was associated with Hb drop, and the risk factors for Hb level < 8 g/dL on postoperative day 2 were bilateral HRS and Dega osteotomy in the HRS subgroup. In total, 21.6% had elevated AST levels on postoperative day 2, and bilateral HRS ($p < 0.001$), Gross Motor Function Classification System (GMFCS) level V ($p = 0.041$), Dega osteotomy ($p < 0.001$), and high preoperative AST level ($p < 0.001$) increased the risk of AST elevation.

Conclusions: We have summarized the estimated blood loss and related laboratory changes after SEMLS and HRS in patients with CP and identified the risk factors. Clinical guidelines should be accordingly developed to include assessment of these risk factors and their impact in the outcomes of CP patients undergoing SEMLS and HRS.

PMID: 34484634

7. Understanding skeletal muscle in cerebral palsy: a path to personalized medicine?
Jason J Howard, Kerr Graham, Adam P Shortland

Review Dev Med Child Neurol. 2021 Sep 9. doi: 10.1111/dmcn.15018. Online ahead of print.

Until recently, there has been little interest in understanding the intrinsic features associated with the pathomorphology of skeletal muscle in cerebral palsy (CP). Coupled with emerging evidence that challenges the role of spasticity as a determinant of gross motor function and in the development of fixed muscle contractures, it has become increasingly important to further elucidate the underlying mechanisms responsible for muscle alterations in CP. This knowledge can help clinicians to understand and apply treatment modalities that take these aspects into account. Thus, the inherent heterogeneity of the CP phenotype allows for the potential of personalized medicine through the understanding of muscle pathomorphology on an individual basis and tailoring treatment approaches accordingly. This review aims to summarize recent developments in the understanding of CP muscle and their relationship to musculoskeletal manifestations, in addition to proposing a treatment paradigm that incorporates this new knowledge.

PMID: 34499350

8. Will individuals with cerebral palsy have better musculoskeletal care in 30 years?
Tom F Novacheck

Editorial Dev Med Child Neurol. 2021 Oct;63(10):1133. doi: 10.1111/dmcn.14999.

PMID: 34490620

9. Physical therapy treatments incorporating equine movement: a pilot study exploring interactions between children with cerebral palsy and the horse
Priscilla Lightsey, Yonghee Lee, Nancy Krenek, Pilwon Hur

J Neuroeng Rehabil. 2021 Sep 6;18(1):132. doi: 10.1186/s12984-021-00929-w.

Background: Physical therapy treatments incorporating equine movement are recognized as an effective tool to treat functional mobility and balance in children with cerebral palsy (CP). To date, only a few studies examined kinematic outputs of the horses and children when mounted. In this pilot study, to better understand the effectiveness of this type of treatment, we examined the interaction between the horses and children with CP during physical therapy sessions where equine movement was utilized. Methods: Four children with CP participated in eight physical therapy sessions incorporating hippotherapy as a treatment intervention. Functional mobility was assessed using the Timed Up Go or the 10 m Walk Test. Inertial measurement unit sensors, attached to children and horses, recorded movements and tracked acceleration, angular velocity, and body orientation. Correlation between vertical accelerations of children and horses were analyzed. In addition, peak frequencies of vertical accelerations of children and horses were compared. Results: Functional tests modestly improved over time. The children's movements, (quantified in frequency and temporal domains) increasingly synchronized to the vertical movement of the horse's walk, demonstrated by reduced frequency errors and increased correlation. Conclusions: The findings suggest that as the sessions progressed, the participants appeared to become more familiar with the horse's movement. Since the horse's gait at a walk mimics the human gait this type of treatment may provide individuals with CP, who have abnormal gait patterns, an opportunity for their neuromuscular system to experience a typical gait pattern. The horse's movement at the walk are consistent, cyclical, rhythmical, reciprocal and multi-dimensional, all of which can facilitate motor learning. The increased synchronization between horse and the mounted participant suggests that physical therapy utilizing equine movement is a

viable treatment tool to enhance functional mobility. This study may provide a useful baseline for future work. Trial registration Texas A&M University Institutional Review Board. IRB2018-0064. Registered 8 March 2018. Link: https://rcb.tamu.edu/humans/irb and https://github.com/pilwonhur/HPOT

PMID: 34488800

10. Effect of Community-Based Functional Aerobic Training on Motor Performance and Quality of Life of Children with Spastic Cerebral Palsy
Evans Osei Owusu Ansa, Wisdom Kwadwo Mprah, Monday Omoniyi Moses, Isaac Owusu, Enoch Acheampong

Ethiop J Health Sci. 2021 May;31(3):505-516. doi: 10.4314/ejhs.v31i3.7.

Background: Efficacies of community-based exercise programmes have been well reported but there is scarce information on the expediency of community-based rehabilitation in a society where many of children with disabilities live in poorly resourced settings with extremely limited rehabilitative services. The study investigated the effects of community-based functional aerobic exercise (CBFAE) on gross motor function, walking distance, and quality of life of children with cerebral palsy (CP). Methods: Quasi-experimental design was used. Children with gross motor function classification system (GMFCS) levels I - II participated in eight weeks CBFAE training four times/week, 50 minutes/day at 40-80% maximum heart rate. Gross motor function (GMF), walk distance and quality of life were assessed pre and post CBFAE training. Results: Significant improvement observed in GMF (Dstanding) (8.2%, P=.000), GMF (E-walking+running+jumping (5.12%, P=.004), walking distance (6.09%, P=.009). Higher significant positive effects of CBFAE observed in Social wellbeing and acceptance (107.10%, P=.000), and participation and physical health (105.04%, P=.005) by children parent proxy. Self-reported results showed that for CBFAE, significant positive improvements were higher in Pain and impact of disability (67.93%, P=.049) and Participation and physical health (60.00%, P=.042). Conclusion: CBFAE training contributes majorly to improved standing, walking, jumping and running and selfesteem, quality of life of children with spastic CP. Clinicians and exercise therapists should essentially incorporate CBFAE training and activities into the management of children with CP for improved mobility and functional performances.

PMID: 34483607

11. Physical activity, sedentary time and nutritional status in Brazilian children with cerebral palsy
Raíne Costa Borba Firmino Arruda, Rafael Miranda Tassitano, Anísio Luís da Silva Brito, Olga Sophia de Souza Martins, Poliana Coelho Cabral, Margarida Maria de Castro Antunes

J Pediatr (Rio J). 2021 Sep 7;S0021-7557(21)00119-4. doi: 10.1016/j.jped.2021.07.005. Online ahead of print.

Objective: This study had the purpose investigate the physical activity (PA) and sedentary time profile of children with cerebral palsy and its association with body composition. Methods: A cross-sectional study evaluated 53 children, between 2 and 10 years old, enrolled in three health services Recife-city, northeast of Brazil. Sedentary and PA were measured for a week using the ActiGraph GTX3 accelerometer. Body composition was assessed by anthropometry and an electrical bioimpedance device. Results: Time on PA was one hour longer among the mild/moderate CP compared to severe ones, but, sedentary time is similar. Dyskinetic children spent more time in PA, but also in sedentary activities (15.5 hours a day) than spastic ones (12.8). Stunting occurred in 15 (30%) of the sample, all children with stunting had severe impairment. Underweight occurred in 25% of the severe group and 11.8% in the mild/moderate group. Overweight affected 3% of the sample; no overweight children were in the severe group. Body fat% was inversely related to time spent in moderate to vigorous PA. Conclusions: Children with CP spend more than a half of their daily time in sedentary activity. In contrast, children with mild to moderate CP spent twice as much time in moderate to vigorous PA and had a tendency (p = 0.07) to spend 50% more time in light PA. Moreover, time spent on moderate to vigorous activity was inversely related to fat mass.

PMID: 34506748

12. Perceived barriers and facilitators for increasing the physical activity of adolescents and young adults with cerebral palsy: a focus group study
Ronit Aviram, Natalia Khvorostianov, Netta Harries, Simona Bar-Haim

Disabil Rehabil. 2021 Sep 9;1-11. doi: 10.1080/09638288.2021.1970252. Online ahead of print.

Purpose: Identifying the factors impacting physical activity (PA) among adolescents and young adults with cerebral palsy (CP). Methods: Four focus groups were conducted, with a total of 22 participants with CP, aged 14-24 years, Gross Motor Function Classification (GMFCS) I-III. Our qualitative analysis drew on grounded theory and used Atlas software. Results: Findings revealed four categories of factors impacting PA: (1) Musculoskeletal-pain and additional impairments related to activity limitations; (2) knowledge and exercising skills, and life skills such as problem-solving, decision-making, planning and organizing; (3) availability: lack of transportation, professional guidance, adapted and community-based programs, especially enjoyable activities; (4) social support from professionals (mainly physiotherapists) and peer support with socializing opportunities. Many opposed parental involvement. Those who attended special education schools and had moderate to severe learning disabilities saw PA as an opportunity for social contacts, limited by lack of availability. Those in mainstream schools with mild to no learning disabilities used PA for relieving pain and preserving function, limited by difficulty balancing PA and life goals. Conclusions: Service providers should inculcate knowledge and active-living skills during the transition to adulthood. Professional guidance needed to ensure inclusion in communal PA and offer adapted programs for young people with CP. IMPLICATIONS FOR REHABILITATION: There is a need for ongoing, accessible, adapted, community-based physical activity programs for young adults with CP guided by skilled professionals that can provide them with opportunities for enjoyable activities involving social interactions. When planning treatment interventions for children and young individuals with CP, healthcare providers should be aware of past therapeutic experiences and in collaboration with parents, are encouraged to be sensitive to possible tensions which may exist regarding their body care. Healthcare and educational professionals should provide young people with CP and their families with theoretical and practical knowledge about physical activity and its health benefits, as well as information about exercise options. Developing life skills in young adults with CP is important for helping them to effectively engage in physical activity and develop the competencies needed to achieve long term physical care.

PMID: 34498999

13. A Study on Physical Exercise and General Mobility in People with Cerebral Palsy: Health through Costless Routines
Alberto J Molina-Cantero, Manuel Merino-Monge, Juan A Castro-García, Thais Pousada-García, David Valenzuela-Muñoz, Juan Gutiérrez-Párraga, Setefilla López-Álvarez, Isabel M Gómez-González

Int J Environ Res Public Health. 2021 Aug 31;18(17):9179. doi: 10.3390/ijerph18179179.

Sedentary behavior (SB) is a common problem that may produce health issues in people with cerebral palsy (CP). When added to a progressive reduction in motor functions over time, SB can lead to higher percentages of body fat, muscle stiffness and associated health issues in this population. Regular physical activity (RPA) may prevent the loss of motor skills and reduce health risks. In this work, we analyzed data collected from 40 people (20 children and teenagers, and 20 adults) who attend two specialist centers in Seville to obtain an up-to-date picture regarding the practice of RPA in people with CP. Roughly 60% of the participants showed mostly mid/severe mobility difficulties, while 38% also had communicative issues. Most of the participants performed light-intensity physical activity (PA) at least once or twice a week and, in the majority of cases, had a neutral or positive attitude to exercising. In the Asociación Sevillana de Parálisis Cerebral (ASPACE) sample test, the higher the International Classification of Functioning, Disability and Health (ICF), the higher the percentage of negative responses to doing exercise. Conversely, in the Centro Específico de Educación Especial Mercedes Sanromá (CEEEMS), people likes PA but slightly higher ratios of positive responses were found at Gross Motor Function Classification System (GMFCS) levels V and II, agreeing with the higher personal engagement of people at those levels. We have also performed a literature review regarding RPA in CP and the use of low-cost equipment. As a conclusion, we found that RPA produces enormous benefits for health and motor functions, whatever its intensity and duration. Costless activities such as walking, running or playing sports; exercises requiring low-cost equipment such as elastic bands, certain smartwatches or video-games; or therapies with animals, among many others, have all demonstrated their suitability for such a purpose.

PMID: 34501769

14. A First Clinical Trial on Botulinum Toxin-A for Chronic Muscle-Related Pain in Cerebral Palsy
Dan Jacobson, Kristina Löwing, Kjell Kullander, Britt-Marie Rydh, Kristina Tedroff

Front Neurol. 2021 Aug 16;12:696218. doi: 10.3389/fneur.2021.696218. eCollection 2021.

Objective: To test if botulinum toxin-A (BoNT-A) is effective in reducing chronic muscle-related pain in adults with spastic cerebral palsy (CP), as compared to placebo. Design: A single-center, double-blind, parallel, randomized placebo-controlled trial. The design included an interim analysis to allow for confirmatory analysis, as well as pilot study outcomes. Setting: Tertiary university hospital. Participants: Adults with spastic CP and chronic pain associated with spastic muscle(s). Intervention: Treatment was one session of electromyographically guided intramuscular injections of either BoNT-A or placebo normosaline. Main Study Outcomes: The primary outcome was the proportion who achieved a reduction of pain intensity of two or more steps on the Numerical Rating Scale 6 weeks after treatment. Results: Fifty individuals were screened for eligibility, of whom 16 were included (10 female, 6 male, mean age = 32 years, SD = 13.3 years). The randomization yielded eight participants per treatment arm, and all completed the study as randomized. The study was stopped at the interim analysis due to a low probability, under a preset threshold, of a positive primary outcome. Four individuals were treatment responders in the BoNT-A group for the primary outcome compared to five responders in the placebo group ($p = 1.000$). Adverse events were mild to moderate. In exploratory analysis, the BoNT-A group had a trend of continuing reduction of pain at the last follow-up, after the primary endpoint. Conclusions: This study did not find evidence that BoNT-A was superior to placebo at the desired effect size (number needed to treat of 2.5) at 6 weeks after treatment. Trial registration: ClinicalTrials.gov: NCT02434549.

PMID: 34484101

15. How does a systematic tuning protocol for ankle foot orthosis-footwear combinations affect gait in children in cerebral palsy?
Laura M Oudenhoven, Yvette L Kerkum, Annemieke I Buizer, Marjolein M van der Krogt

Disabil Rehabil. 2021 Sep 10;1-11. doi: 10.1080/09638288.2021.1970829. Online ahead of print.

Purpose: To investigate the effects of a systematic tuning protocol for ankle foot orthosis footwear combinations (AFO-FC) using incrementing heel height on gait in children with cerebral palsy (CP). Methods: Eighteen children with CP (10.8 ± 3 years, Gross Motor Function Classification System (GMFCS) I-II) underwent 3D gait analysis on a treadmill, while the AFO heel surface was systematically incremented with wedges. Children were subdivided based on their gait pattern, i.e., knee hyperextension (EXT) and excessive knee flexion (FLEX). Outcome measures included sagittal hip and knee angles and moments, shank to vertical angle (SVA), foot to horizontal angle, and gait profile score (GPS). Results: For both groups, incrementing heel height resulted in increased knee flexion, more inclined SVA, and increased knee extension moments. This resulted in gait improvements for some children of the EXT-group, but not in FLEX. High variation was found between individuals and within-subject effects were not always consistent for kinematic and kinetics. Conclusions: A systematic AFO-FC tuning protocol using incremented heel height can be effective to improve gait in children with CP walking with EXT. The current results emphasise the importance of including kinematics as well as kinetics of multiple instances throughout the gait cycle for reliable interpretation of the effect of AFO tuning on gait. Implications for rehabilitation: A systematic ankle foot orthosis footwear combinations (AFO-FC) tuning protocol using incremented heel height can improve gait in children walking with knee hyperextension. Tuning results in changes throughout the gait cycle. Little evidence is found for an optimal SVA of 10-12° at midstance. For clinical interpretation, both joint kinematic and kinetic parameters should be considered throughout the gait cycle and evaluation should not be based on SVA only.

PMID: 34506245

16. Robotic devices for paediatric rehabilitation: a review of design features
Alberto Gonzalez, Lorenzo Garcia, Jeff Kilby, Peter McNair

Review Biomed Eng Online. 2021 Sep 6;20(1):89. doi: 10.1186/s12938-021-00920-5.

Children with physical disabilities often have limited performance in daily activities, hindering their physical development, social development and mental health. Therefore, rehabilitation is essential to mitigate the adverse effects of the different

causes of physical disabilities and improve independence and quality of life. In the last decade, robotic rehabilitation has shown the potential to augment traditional physical rehabilitation. However, to date, most robotic rehabilitation devices are designed for adult patients who differ in their needs compared to paediatric patients, limiting the devices' potential because the paediatric patients' needs are not adequately considered. With this in mind, the current work reviews the existing literature on robotic rehabilitation for children with physical disabilities, intending to summarise how the rehabilitation robots could fulfil children's needs and inspire researchers to develop new devices. A literature search was conducted utilising the Web of Science, PubMed and Scopus databases. Based on the inclusion-exclusion criteria, 206 publications were included, and 58 robotic devices used by children with a physical disability were identified. Different design factors and the treated conditions using robotic technology were compared. Through the analyses, it was identified that weight, safety, operability and motivation were crucial factors to the successful design of devices for children. The majority of the current devices were used for lower limb rehabilitation. Neurological disorders, in particular cerebral palsy, were the most common conditions for which devices were designed. By far, the most common actuator was the electric motor. Usually, the devices present more than one training strategy being the assistive strategy the most used. The admittance/impedance method is the most popular to interface the robot with the children. Currently, there is a trend on developing exoskeletons, as they can assist children with daily life activities outside of the rehabilitation setting, propitiating a wider adoption of the technology. With this shift in focus, it appears likely that new technologies to actuate the system (e.g. serial elastic actuators) and to detect the intention (e.g. physiological signals) of children as they go about their daily activities will be required.

PMID: 34488777

17. Wheelchair-Mounted Upper Limb Robotic Exoskeleton with Adaptive Controller for Activities of Daily Living
Bridget Schabron, Jaydip Desai, Yimesker Yihun

Sensors (Basel). 2021 Aug 26;21(17):5738. doi: 10.3390/s21175738.

Neuro-muscular disorders and diseases such as cerebral palsy and Duchenne Muscular Dystrophy can severely limit a person's ability to perform activities of daily living (ADL). Exoskeletons can provide an active or passive support solution to assist these groups of people to perform ADL. This study presents an artificial neural network-trained adaptive controller mechanism that uses surface electromyography (sEMG) signals from the human forearm to detect hand gestures and navigate an in-house-built wheelchair-mounted upper limb robotic exoskeleton based on the user's intent while ensuring safety. To achieve the desired position of the exoskeleton based on human intent, 10 hand gestures were recorded from 8 participants without upper limb movement disabilities. Participants were tasked to perform water bottle pick and place activities while using the exoskeleton, and sEMG signals were collected from the forearm and processed through root mean square, median filter, and mean feature extractors prior to training a scaled conjugate gradient backpropagation artificial neural network. The trained network achieved an average of more than 93% accuracy, while all 8 participants who did not have any prior experience of using an exoskeleton were successfully able to perform the task in less than 20 s using the proposed artificial neural network-trained adaptive controller mechanism. These results are significant and promising thus could be tested on people with muscular dystrophy and neuro-degenerative diseases.

PMID: 34502632

18. Computer Game-Based Telerehabilitation Platform Targeting Manual Dexterity: Exercise Is Fun. "You Are Kidding-Right?"
Sanjay Tejraj Parmar, Anuprita Kanitkar, Nariman Sepehri, Satish Bhairannawar, Tony Szturm

Sensors (Basel). 2021 Aug 27;21(17):5766. doi: 10.3390/s21175766.

There is a need for innovation to improve the engagement and accessibility of rehabilitation programs for children and adults with upper extremity motor impairments due to neurodevelopmental disorders, acquired brain injuries, or spinal cord injuries. For this purpose, a computer game-based telerehabilitation platform (GTP) was developed to address this need. Through the application of a miniature inertial-based computer mouse and the wide variety of commercial computer games, the developed GTP can provide engaging task-specific exercises for the rehabilitation of manual dexterity (object handling and manipulation). A purpose-built repetitive task practice software (RTP) was also developed to gather event data and synchronize it with patient movements during gameplays. This provides automated monitoring and quantification of patients' motor skills, while they practice a range of game-based exercises with their hand and/or arm. The GTP would initially be used in a supervised clinical setting followed by a transition to function at home and be monitored by clinician specialists. Clinical support for home and

rural communities, with protocols that can be easily updated, will help increase accessibility to targeted and personalized solutions for patients and achieve the desired training effect.

PMID: 34502656

19. Robotic devices for paediatric rehabilitation: a review of design features
Alberto Gonzalez, Lorenzo Garcia, Jeff Kilby, Peter McNair

Review Biomed Eng Online. 2021 Sep 6;20(1):89. doi: 10.1186/s12938-021-00920-5.

Children with physical disabilities often have limited performance in daily activities, hindering their physical development, social development and mental health. Therefore, rehabilitation is essential to mitigate the adverse effects of the different causes of physical disabilities and improve independence and quality of life. In the last decade, robotic rehabilitation has shown the potential to augment traditional physical rehabilitation. However, to date, most robotic rehabilitation devices are designed for adult patients who differ in their needs compared to paediatric patients, limiting the devices' potential because the paediatric patients' needs are not adequately considered. With this in mind, the current work reviews the existing literature on robotic rehabilitation for children with physical disabilities, intending to summarise how the rehabilitation robots could fulfil children's needs and inspire researchers to develop new devices. A literature search was conducted utilising the Web of Science, PubMed and Scopus databases. Based on the inclusion-exclusion criteria, 206 publications were included, and 58 robotic devices used by children with a physical disability were identified. Different design factors and the treated conditions using robotic technology were compared. Through the analyses, it was identified that weight, safety, operability and motivation were crucial factors to the successful design of devices for children. The majority of the current devices were used for lower limb rehabilitation. Neurological disorders, in particular cerebral palsy, were the most common conditions for which devices were designed. By far, the most common actuator was the electric motor. Usually, the devices present more than one training strategy being the assistive strategy the most used. The admittance/impedance method is the most popular to interface the robot with the children. Currently, there is a trend on developing exoskeletons, as they can assist children with daily life activities outside of the rehabilitation setting, propitiating a wider adoption of the technology. With this shift in focus, it appears likely that new technologies to actuate the system (e.g. serial elastic actuators) and to detect the intention (e.g. physiological signals) of children as they go about their daily activities will be required.

PMID: 34488777

20. Real-time linear prediction of simultaneous and independent movements of two finger groups using an intracortical brain-machine interface
Samuel R Nason, Matthew J Mender, Alex K Vaskov, Matthew S Willsey, Nishant Ganesh Kumar, Theodore A Kung, Parag G Patil, Cynthia A Chestek

Neuron. 2021 Sep 3;S0896-6273(21)00604-8. doi: 10.1016/j.neuron.2021.08.009. Online ahead of print.

Modern brain-machine interfaces can return function to people with paralysis, but current upper extremity brain-machine interfaces are unable to reproduce control of individuated finger movements. Here, for the first time, we present a real-time, high-speed, linear brain-machine interface in nonhuman primates that utilizes intracortical neural signals to bridge this gap. We created a non-prehensile task that systematically individuates two finger groups, the index finger and the middle-ring-small fingers combined. During online brain control, the ReFIT Kalman filter could predict individuated finger group movements with high performance. Next, training ridge regression decoders with individual movements was sufficient to predict untrained combined movements and vice versa. Finally, we compared the postural and movement tuning of finger-related cortical activity to find that individual cortical units simultaneously encode multiple behavioral dimensions. Our results suggest that linear decoders may be sufficient for brain-machine interfaces to execute high-dimensional tasks with the performance levels required for naturalistic neural prostheses.

PMID: 34499856

21. Sensitivity to Communication Partners During Naturalistic AAC Conversations in Cantonese Chinese
Yen Na Yum, Soby Ka Wing So, Rosanna Yuen-Yan Chan

Front Psychol. 2021 Aug 18;12:686657. doi: 10.3389/fpsyg.2021.686657. eCollection 2021.

Previous studies have shown that graphic-based augmentative and alternative communication (AAC) output tend to be short and simple in structure with non-canonical word order, and that AAC users may show differences when communicating with peers compared to professionals such as speech therapists (STs). However, there was a lack of report for graphic-based AAC in the Chinese context, and the effect of communication partners had not been investigated systematically. In this study with 34 AAC users and 10 STs, we reported common and distinct features of free conversations in Cantonese graphic-based AAC, relative to AAC in other languages. We also found that AAC users were sensitive to different types of communication partners. In particular, when conversing with peers, AAC users produced long messages with equal proportion of questions and responses, which suggested active and bi-directional exchanges. In conversations with STs, AAC users showed high diversity in expressive vocabulary, indicating access to more semantic concepts. Results suggested that the base language and the communication partner are both influential factors that should be considered in studies of graphic-based AAC. The mobile AAC system facilitated free conversations in users with complex communication needs, affording an additional channel for social participation.

PMID: 34489796

22. Technology-assisted quantification of movement to predict infants at high risk of motor disability: A systematic review
Christian B Redd, Mohan Karunanithi, Roslyn N Boyd, Lee A Barber

Res Dev Disabil. 2021 Sep 7;118:104071. doi: 10.1016/j.ridd.2021.104071. Online ahead of print.

Aim: To systematically review the scientific literature to determine the predictive validity of technology-assisted measures of observable infant movement in infants less than six months of corrected age (CA) to identify high-risk of motor disability. Method: A comprehensive search for randomised and non-randomised controlled trials, cohort studies and cross-comparison trials was performed on five electronic databases up to Feb 2021. Studies were included if they quantified infant movement before 6 months CA using some method of technology-assistance and compared the instrumented measure to a diagnostic clinical measure of neurodevelopment. Studies were excluded if they did not report a technology-assisted measure of infant movement. Methodological quality of the included studies was assessed using the Downs and Black scale. Results: 23 studies met the full inclusion and exclusion criteria. Methodological quality of the included papers ranged from 9 to 24 (out of 26) on the Downs and Black scale. Infant movement assessments included the General Movements Assessment (GMA) and domains of the Hammersmith Infant Neurological Assessment (HINE). Studies used 2D video recordings, RGB-Depth recordings, accelerometry, and electromagnetic motion tracking technologies to quantify movement. Analytical approaches and movement features of interest were individual and varied. Technology assisted quantitative assessments identified cases of later diagnosed CP with sensitivity 44-100 %, specificity 59-95 %, Area under the ROC Curve 82-93 %; and typical development with sensitivity range 30-46 %, specificity 88-95 %, Area under the ROC Curve 68 %. Interpretation: Technology-assisted assessments of movement in infants less than 6 months CA using current technologies are feasible. Validation of measurement tools are limited. Although methods and results appear promising clinical uptake of technology-assisted assessments remains limited.

PMID: 34507051

23. Prevalence and Initial Diagnosis of Cerebral Palsy in Preterm and Term-Born Children in Taiwan: A Nationwide, Population-Based Cohort Study
Hsin-Hua Wang, Yea-Shwu Hwang, Chung-Han Ho, Ming-Chi Lai, Yu-Chin Chen, Wen-Hui Tsai

Int J Environ Res Public Health. 2021 Aug 26;18(17):8984. doi: 10.3390/ijerph18178984

The aim of this long-term longitudinal study in Taiwan was to estimate and compare the prevalence of cerebral palsy (CP) and to identify the age of CP diagnosis of term-born and preterm children with different birthweights. Records of 1494 extremely

low birth weight (ELBW, <1000 g), 3961 very low birth weight (VLBW, 1000-1499 g), 19,612 low birth weight (LBW, 1500-2499 g) preterm, and 100,268 matched term-born children were retrieved from Taiwan's National Health Insurance Research Database. According to a 12-year retrospective data review, the results showed the highest prevalence of CP in preterm ELBW children (147.3 cases per 1000 neonatal survivors), followed by preterm VLBW (97.2 cases), preterm LBW (27.7 cases), with the lowest prevalence in term-born children (2.5 cases). Regardless of the birthweight group, 90% of preterm children with CP were diagnosed by 4 years of age, but it was 7 years before 90% of term-born children with CP were diagnosed. After removing the children whose CP was caused by brain infections, injuries, or cerebrovascular accidents after 4 months of age, there were similar mean ages at the initial CP diagnosis (1.58-1.64 years of age) across birthweight groups born prematurely, but initial diagnosis occurred at an older age (2.41 years of age) in term-born children. The results indicate that birthweight is reversely correlated with the prevalence of CP in preterm children. Although the three preterm birthweight groups received different types of developmental follow-up programs after birth, it did not influence their age at the initial diagnosis of CP. Furthermore, we suggest that follow-up for at least 4 years after birth for preterm children, and 7 years for term-born children, is optimal for estimating CP prevalence. In order to identify and provide early intervention for term-born children with CP earlier, it is suggested that parents routinely fill out a self-reported motor developmental screening questionnaire and pediatricians conduct a motor developmental examination on term-born children at each time of scheduled vaccination injections.

PMID: 34501573

24. Causation of cerebral palsy: the huge knowledge gap between populations and individuals
Vijeya Ganesan

Dev Med Child Neurol. 2021 Sep 9. doi: 10.1111/dmcn.15051. Online ahead of print.

PMID: 34498742

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25. Astroglial Hemichannels and Pannexons: The Hidden Link between Maternal Inflammation and Neurological Disorders
Juan Prieto-Villalobos, Tanhia F Alvear, Andrés Liberona, Claudia M Lucero, Claudio J Martínez-Araya, Javiera Balmazabal, Carla A Inostroza, Gigliola Ramírez, Gonzalo I Gómez, Juan A Orellana

Review Int J Mol Sci. 2021 Sep 1;22(17):9503. doi: 10.3390/ijms22179503

Maternal inflammation during pregnancy causes later-in-life alterations of the offspring's brain structure and function. These abnormalities increase the risk of developing several psychiatric and neurological disorders, including schizophrenia, intellectual disability, bipolar disorder, autism spectrum disorder, microcephaly, and cerebral palsy. Here, we discuss how astrocytes might contribute to postnatal brain dysfunction following maternal inflammation, focusing on the signaling mediated by two families of plasma membrane channels: hemi-channels and pannexons. [Ca2+]i imbalance linked to the opening of astrocytic hemichannels and pannexons could disturb essential functions that sustain astrocytic survival and astrocyte-to-neuron support, including energy and redox homeostasis, uptake of K+ and glutamate, and the delivery of neurotrophic factors and energy-rich metabolites. Both phenomena could make neurons more susceptible to the harmful effect of prenatal inflammation and the experience of a second immune challenge during adulthood. On the other hand, maternal inflammation could cause excitotoxicity by producing the release of high amounts of gliotransmitters via astrocytic hemichannels/pannexons, eliciting further neuronal damage. Understanding how hemichannels and pannexons participate in maternal inflammation-induced brain abnormalities could be critical for developing pharmacological therapies against neurological disorders observed in the offspring.

PMID: 34502412

26. A Proposed Clinical Classification and a Diagnostic Approach for Congenital Ataxias
Ivana Rocha Raslan, Orlando G Barsottini, José Luiz Pedroso

Review Neurol Clin Pract. 2021 Jun;11(3):e328-e336. doi: 10.1212/CPJ.0000000000000966.

Purpose of review: This review proposes a clinical classification for congenital ataxias based on clinical features, neuroimaging, and course of the disease. Recent findings: Congenital ataxias are an unusual group of neurologic disorders, with heterogeneous clinical and genetic presentation. Typical clinical features of congenital ataxias include variable degrees of motor developmental delay, very early onset cerebellar ataxia, cognitive impairment, and hypotonia, frequently mistakenly diagnosed as cerebral palsy. Congenital ataxias are usually nonprogressive. Neuroimaging plays an important role in the characterization of congenital ataxias. Despite the development of genetics with exome sequencing, several congenital ataxias remain undetermined, and medical literature on this topic is scarce. Summary: A didactic classification based on the clinical and neuroimaging features for congenital ataxias include the following 4 main groups: cerebellar malformation, syndromic congenital ataxias, congenital cerebellar hypoplasia, and pontocerebellar hypoplasia. A diagnostic approach for congenital ataxias is proposed, and its differential diagnosis is also discussed.

PMID: 34484907

27. Predictive performance and metabolite dynamics of proton MR spectroscopy in neonatal hypoxic-ischemic encephalopathy

Hajnalka Barta, Agnes Jermendy, Livia Kovacs, Noemie Schiever, Gabor Rudas, Miklos Szabo

Pediatr Res. 2021 Sep 6. doi: 10.1038/s41390-021-01626-z. Online ahead of print.

Background: Prognostic value of proton MR spectroscopy (H-MRS) in hypoxic-ischemic encephalopathy (HIE) is acknowledged; however, effects of gestational age (GA) and postnatal age (PA) on prediction and metabolite levels are unknown. Methods: One hundred and sixty-nine newborns with moderate-to-severe HIE were studied, having ≥1 H-MRS scan during postnatal days 0-14 and known neurodevelopmental outcome (Bayley-II score/cerebral palsy/death). Initial scans were categorized by PA (day 1-3/4-6/≥7), and metabolite ratios were compared by predictive value. Metabolite dynamics were assessed in a total of 214 scans performed in the study population, using regression modeling, with predictors GA, PA, and outcome. Results: N-acetyl-aspartate (NAA)/creatine (Cr) and myo-inositol (mI)/NAA height ratios were consistently associated with outcome throughout the first 14 days, with the highest predictive value in the late (≥7 days) period (AUC = 0.963 and 0.816, respectively). Neither GA nor PA had an overall effect on these metabolite ratios, which showed strongest association with outcome ($p < 0.001$). Assessed separately in patients with good outcome, GA became a significant covariate for metabolite ratios ($p = 0.0058$ and 0.0002, respectively). However, this association disappeared in the poor outcome group. Conclusions: In HIE, NAA/Cr and mI/NAA give most accurate outcome prediction throughout postnatal days 0-14. GA only affected metabolite levels in the good outcome group. Impact: Proton MR spectroscopy metabolite ratios N-acetyl-aspartate/creatine and myo-inositol/N-acetyl-aspartate have persistently high predictive value throughout postnatal days 0-14 in newborns with hypoxic-ischemic encephalopathy, with the highest predictive power between postnatal days 7 and 14. Overall, neither metabolite ratio was affected by gestational age nor by postnatal age, while they showed the strongest association with neurological outcome. However, in newborns facing good outcome, metabolite ratios were associated with gestational age, whereas in cases facing poor outcome, this association disappeared. Proton MR spectroscopy provides valuable prognostic information in neonatal hypoxic-ischemic encephalopathy throughout the first 2 weeks of life, irrespective of the timing of MR scan.

PMID: 34489532

28. Neurodevelopmental Trajectories of Preterm Born Twin-Twin Transfusion Syndrome Survivors: From Birth to 5 Years of Age

Patricia J C Knijnenburg, Marjolijn S Spruijt, Lisette Jansen, Monique Rijken, Ratna N G B Tan, Femke Slaghekke, Johanna M Middeldorp, Enrico Lopriore, Jeanine M M van Klink

J Pediatr. 2021 Sep 7;S0022-3476(21)00874-X. doi: 10.1016/j.jpeds.2021.09.002. Online ahead of print.

Objective: To investigate the neurodevelopmental outcome at two and five years of age in survivors of twin-twin transfusion syndrome (TTTS) treated with fetoscopic laser surgery and born premature- and/or small for gestational age. Study design: At two and five years of age, standardized neurological, motor, and cognitive assessments were performed by a neonatologist, a pediatric physical therapist and psychologist. Behavior was assessed using a validated questionnaire completed by parents. Results: Neurodevelopmental assessment at both timepoints was available for 73 TTTS survivors. At five years, mild to

moderate NDI was detected in 34% (25/73) versus 25% (18/73; P=.178) at two years. Severe NDI was observed in 12% (9/73) at five years and in 3% (2/73; P=.035) at two years. Cognitive scores were lower at five year follow-up, 90.7 ± 12.3 versus 95.6 ± 13.1 at two years (P=.001) and more children were diagnosed with mild cognitive impairment, 29% versus 11% at two years (P=.007). When comparing individual outcomes at both timepoints, 35% (25/71) moved from a normal outcome or mild to moderate impairment at two years towards a more severe impairment at five years. Conclusions: A high proportion of mild to moderate cognitive impairment and severe NDI at the age of five was not identified at two years of age. Our data highlight the importance of longitudinal follow-up of TTTS survivors beyond age two and emphasize the precaution that should be taken when diagnosing an absence of impairment prior to school age.

PMID: 34506853

29. Association Between Pediatric Inpatient Rehabilitation Services and Children's Functional Outcomes: King Fahad Medical City Experience
Sanaa Mohammed Madi, Naif Ibrahim Alraddadi

Rehabil Process Outcome. 2020 Jun 15;9:1179572720928394. doi: 10.1177/1179572720928394. eCollection 2020.

Background: Disability may affect children's performance of functional activities. This may translate to difficulties in returning to home and/or school. It has been documented that intensive rehabilitation programs for children with disabilities lead to an improvement in their functional abilities. Wee-FIM is a valid and reliable outcome measure that is used commonly with children undergoing rehabilitation. Objectives: To study changes in the functional status of children admitted to a specialized pediatric inpatient rehabilitation unit. Design: A retrospective cohort study. Setting: King Fahad Medical City-Rehabilitation Hospital, Riyadh, Saudi Arabia. Methods: Investigators reviewed records of children admitted to a pediatric rehabilitation unit between January 1, 2012, and December 31, 2017. The outcome measures used were rehabilitation length of stay (LOS), Wee-FIM gain, and Wee-FIM efficiency. Results: The total number of records included in this study was 361 records. Sixty percent of the children were boys. The mean age was 8.7 ± 3.8 years (range, 3-17 years). Children with cerebral palsy accounted for 45.2% of the children. The mean LOS was 43 days. Children with brain tumors had the shortest LOS compared with children with other diagnoses. Mean (SD) Wee-FIM efficiency was 0.58 (±0.6). Highest Wee-FIM efficiency was observed in children with brain tumors. Average Wee-FIM gain was 20 (±15). The highest functional gain was 27 in children with brain tumors while the lowest was 16 in children with cerebral palsy. Conclusions: Intensive inpatient rehabilitation program is associated with improvement in functional performance in children with a variety of impairments and disabilities.

PMID: 34497465

30. Toward a More Comprehensive Assessment of School Age Children with Hemiplegic Cerebral Palsy
Catherine R Hoyt, Sarah K Sherman, Shelby K Brown, Dillan J Newbold, Ryland L Miller, Andrew N Van, Joshua S Shimony, Mario Ortega, Annie L Nguyen, Bradley L Schlaggar, Nico Uf Dosenbach

Rehabil Process Outcome. 2021 Apr 27;10:11795727211010500. doi: 10.1177/11795727211010500. eCollection 2021.

Background: Cerebral palsy (CP) is the leading cause of disability in children. While motor deficits define CP, many patients experience behavioral and cognitive deficits which limit participation. The purpose of this study was to contribute to our understanding of developmental delay and how to measure these deficits among children with CP. Methods: Children 5 to 15 years with hemiplegic CP were recruited. Cognition and motor ability were assessed. The brain injury associated with observed motor deficits was identified. Accelerometers measured real-world bilateral upper extremity movement and caregivers completed behavioral assessments. Results: Eleven children participated, 6 with presumed perinatal stroke. Four children scored below average intelligence quotient while other measures of cognition were within normal limits (except processing speed). Motor scores confirmed asymmetrical deficits. Approximately one third of scores indicated deficits in attention, behavior, or depression. Conclusions: Our findings corroborate that children with CP experience challenges that are broader than motor impairment alone. Despite the variation in brain injury, all participants completed study procedures. Implications: Our findings suggest that measuring behavior in children with CP may require a more comprehensive approach and that caregivers are amenable to using online collection tools which may assist in addressing the therapeutic needs of children with CP.

PMID: 34497455

31. Relationship among Gross Motor Function, Parenting Stress, Sense of Control, and Depression in Mothers of Children with Cerebral Palsy
Eun-Young Park

Int J Environ Res Public Health. 2021 Sep 2;18(17):9285. doi: 10.3390/ijerph18179285.

The purpose of this study was to investigate the relationship among the gross motor function of children with cerebral palsy and parenting stress, sense of control, and depression in their mothers. Data were collected from 247 children with cerebral palsy and their mothers. To verify the relationship among variables, path analysis was performed. The control variables included the sex and age of the children. The proposed model showed good fit indices. Gross motor function had an indirect effect on parenting stress and depression and a direct effect on parenting stress and self-control (as parenting sense of control). Parenting stress had an indirect effect on depression and a direct effect on self-control and depression. This result suggests the importance of improving the gross motor function in children with cerebral palsy and self-control in the mothers, as well as decreasing parenting stress to reduce the level of the mothers' depression. Considering the mediating effect of self-control on depression, programs designed to enhance self-control could be effective in decreasing depression in mothers of children with cerebral palsy.

PMID: 34501875

32. The importance of assessing parent stress in families with children with severe neuromotor and intellectual disability - a pilot study
Katia De Gaetano, Donatella Saviola, Domenica Brunetti, Antonio De Tanti

Appl Neuropsychol Child. 2021 Sep 7;1-7. doi: 10.1080/21622965.2021.1971525. Online ahead of print.

Parent-related stress represents the level of dysfunction in the parent-child system related to the parents' functioning. The aim of this retrospective pilot study was to assess the degree of stress perceived by mothers and fathers, in the framework of a family-centred approach to rehabilitation. We considered 43 parents of 29 children with cerebral palsy, genetic disorders or brain injury admitted to a neurological rehabilitation center. Parenting stress was assessed with the Parenting Stress Index - Short Form (PSI-SF) self-report questionnaire and a semi-structured investigation of situational stress factors of the family. The cognitive and motor disability of the children were assessed with the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5) and the Gross Motor Function Classification System-(GMFCS), respectively. The results showed that parental stress is directly correlated with the level of cognitive and behavioral disability and not with motor disability. No significant difference was found in the level of stress perceived by mothers and fathers. The effect of a worsening occupational situation seemed to influence the perception of stress more than a change in the formal relationship of the couple, but neither was statistically significant.

PMID: 34491869

33. [Specialized services for adults with developmental disabilities] [Article in Swedish]
Monica von Heijne, Ulrica Jonsson

Lakartidningen. 2021 Sep 7;118:21013.

Adults with developmental disabilities, e.g. intellectual disability, autism, cerebral palsy or neuromuscular diseases, have an increased risk of somatic and psychiatric disorders and of premature death. Many are dependent on others to communicate symptoms and access health care, and standard treatments often need to be individually adapted. The services offered these adults vary between regions. Physicians are scarce and of varying medical background. Adults with developmental disabilities should be entitled to equivalent specialized services, regardless of region of residence. Preventable morbidity and mortality should be minimized. To achieve this: Nurses and physicians should be included in the specialized services in all regions A curriculum for physicians in specialized services is needed The knowledge of developmental disabilities and accompanying health conditions needs to be enhanced throughout the health care system.

PMID: 34498239

34. Risk of early- and late-onset Alzheimer disease and related dementia in adults with cerebral palsy
Elham Mahmoudi, Paul Lin, Neil Kamdar, Gabriella Gonzales, Alexandra Norcott, Mark D Peterson

Dev Med Child Neurol. 2021 Sep 8. doi: 10.1111/dmcn.15044. Online ahead of print.

Aim: To examine the risk of Alzheimer disease and related dementia (ADRD) among adults with cerebral palsy (CP). Method: Using administrative insurance claims data for 2007 to 2017 in the USA, we identified adults (45y or older) with a diagnosis of CP (n=5176). Adults without a diagnosis of CP were included as a typically developing comparison group (n=1 119 131). Using age, sex, ethnicity, other demographic variables, and a set of chronic morbidities, we propensity-matched individuals with and without CP (n=5038). Cox survival models were used to estimate ADRD risk within a 3-year follow up. Results: The unadjusted incidence of ADRD was 9 and 2.4 times higher among cohorts of adults 45 to 64 years (1.8%) and 65 years and older (4.8%) with CP than the respective unmatched individuals without CP (0.2% and 2.0% among 45-64y and 65y or older respectively). Fully adjusted survival models indicated that adults with CP had a greater hazard for ADRD (among 45-64y: unmatched hazard ratio 7.48 [95% confidence interval {CI} 6.05-9.25], matched hazard ratio 4.73 [95% CI 2.72-8.29]; among 65y or older: unmatched hazard ratio 2.21 [95% CI 1.95-2.51], matched hazard ratio 1.73 [1.39-2.15]). Interpretation: Clinical guidelines for early screening of cognitive function among individuals with CP need updating, and preventative and/or therapeutic services should be used to reduce the risk of ADRD.

PMID: 34496036

35. Fentanyl analgesia in asphyxiated newborns treated with therapeutic hypothermia
Licia Lugli, Caterina Spada, Elisabetta Garetti, Isotta Guidotti, Maria Federica Roversi, Elisa Della Casa, Luca Bedetti, Laura Lucaccioni, Marisa Pugliese, Fabrizio Ferrari, Lorenzo Iughetti, Paola Lago, Alberto Berardi

J Matern Fetal Neonatal Med. 2021 Sep 5;1-7. doi: 10.1080/14767058.2021.1937106. Online ahead of print.

Introduction: Therapeutic hypothermia is the standard care for asphyxiated newborns. Discomfort and pain during treatment are common and may affect therapeutic efficacy of hypothermia. Opioid analgosedation is commonly used in the clinical setting, but its effects in the cooled newborns is poorly investigated. Objective: The aim of this study was to assess the safety of fentanyl analgosedation during therapeutic hypothermia, by evaluating severe adverse effects and possible correlation with the neurodevelopmental outcome. Methods: We analyzed asphyxiated newborns treated with hypothermia receiving fentanyl intravenous infusion (years 2013-2018). Severe neurodevelopmental outcome was defined as cerebral palsy or Griffith's developmental quotient <70 or major sensorineural deficit. Severe brain lesions were defined as cortical or/and basal ganglia extensive involvement. Results: Fentanyl cumulative dose was variable (61.7 ± 18.5 µg/kg; range 34.3-120.3 µg/kg) among 45 enrolled patients. Respiratory depression was recorded in 13.3% cases of 30 spontaneously breathing patients. Severe brain lesions and severe neurodevelopmental disability were found in 24.4 and 11.1% of all included cases, respectively. Higher cumulative fentanyl dose was not associated with poor outcome. Conclusions: Fentanyl treatment during therapeutic hypothermia does not negatively affect the neurodevelopmental outcome, thus on the contrary, it may contribute to ameliorate neuroprotection in the asphyxiated cooled newborns.

PMID: 34486466

Prevention and Cure

36. Current Therapies for Neonatal Hypoxic-Ischaemic and Infection-Sensitised Hypoxic-Ischaemic Brain Damage
Konstantina Tetorou, Claudia Sisa, Arzo Iqbal, Kim Dhillon, Mariya Hristova

Review Front Synaptic Neurosci. 2021 Aug 24;13:709301. doi: 10.3389/fnsyn.2021.709301. eCollection 2021.

Neonatal hypoxic-ischaemic brain damage is a leading cause of child mortality and morbidity, including cerebral palsy, epilepsy, and cognitive disabilities. The majority of neonatal hypoxic-ischaemic cases arise as a result of impaired cerebral

perfusion to the foetus attributed to uterine, placental, or umbilical cord compromise prior to or during delivery. Bacterial infection is a factor contributing to the damage and is recorded in more than half of preterm births. Exposure to infection exacerbates neuronal hypoxic-ischaemic damage thus leading to a phenomenon called infection-sensitised hypoxic-ischaemic brain injury. Models of neonatal hypoxia-ischaemia (HI) have been developed in different animals. Both human and animal studies show that the developmental stage and the severity of the HI insult affect the selective regional vulnerability of the brain to damage, as well as the subsequent clinical manifestations. Therapeutic hypothermia (TH) is the only clinically approved treatment for neonatal HI. However, the number of HI infants needed to treat with TH for one to be saved from death or disability at age of 18-22 months, is approximately 6-7, which highlights the need for additional or alternative treatments to replace TH or increase its efficiency. In this review we discuss the mechanisms of HI injury to the immature brain and the new experimental treatments studied for neonatal HI and infection-sensitised neonatal HI.

PMID: 34504417

37. Neurodevelopmental outcome in neonates with hypoxic-ischaemic encephalopathy managed with therapeutic hypothermia in a tertiary-level public hospital outside an intensive care unit setting
S Mbatha, F L Nakwa, K Thandrayen, S Velaphi

Paediatr Int Child Health. 2021 Sep 8;1-6. doi: 10.1080/20469047.2021.1967625. Online ahead of print.

Background: Management of hypoxic-ischaemic encephalopathy (HIE) by therapeutic hypothermia (TH) is a major challenge in low- and middle-income countries (LMIC) because of the limited resources. Clinicians in LMIC offer this intervention outside neonatal intensive care units (NICU). The effect of this practice on neurodevelopmental outcome is not well known. Aim: To determine neurodevelopmental outcome in neonates with HIE managed with TH outside NICU settings. Methods: This was a retrospective descriptive study of neonates with HIE managed with TH and followed up for neurodevelopmental assessment at 12 and 18-24 months postnatal age. Patients were reviewed over a 24-month period. Outcome at 12 and 18-24 months was compared. Results: Of 178 neonates with HIE attending the clinic, there was information on TH for 155 (87.1%), 113 of whom (72.9%) received TH. HIE was moderate in 88% and severe in 10%. Twenty-seven (23.9%) and 16 (14.1%) were assessed at one time-point at 12 or 18-24 months, respectively, 40 (35.3%) at both time-points, and 30 (26.6%) were not assessed. At 18-24 months, 32% had moderate-to-severe disability compared with 6% at 12 months, with the sensitivity and specificity of assessment at 12 months being 50% and 100%, respectively. The disability attrition rate at 18-24 months was 50%. Conclusions: The relatively low prevalence of disability (32%) at 18-24 months suggests that use of TH in a Level 2 nursery is feasible and possibly beneficial. More studies are needed to confirm these findings.

PMID: 34493152

38. Combined hypothermia and mesenchymal stem cells in animal models of neonatal hypoxic-ischaemic encephalopathy: a systematic review
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Background: The objective of this study was to systematically review the literature to determine the effect of combined hypothermia (HTH) and mesenchymal stem cell (MSC) therapy (administered during or immediately before or after HTH) compared with HTH alone on brain injury and neurobehavioural outcomes in animal models of neonatal hypoxic-ischaemic encephalopathy. Methods: Primary outcomes assessed were neuropathological measures and neurobehavioural measures of brain outcome. Secondary outcomes were brain protein proinflammatory cytokine status. Risk of bias (ROB) was assessed with the Systematic Review Centre for Laboratory Animal Experimentation (SYRCLE) ROB assessment tool. Results: Of 393 studies identified, 3 studies in postnatal day 7 (P7) male Sprague-Dawley rats met the inclusion criteria. Meta-analyses were undertaken for neuropathological measures (apoptotic cells, astrocytes, microglia), neurobehavioral measures (rotarod test and negative geotaxis), and proinflammatory cytokine levels. Two of the three studies scored low or unclear ROB across all measures. Treatment with HTH-MSCs together significantly improved astrocyte optical density by standardised mean difference (SMD) of 0.71 [95% confidence interval (CI) -1.14, -0.28]. No other measures showed significant differences. Conclusions: There is insufficient preclinical data to confirm the efficacy of combined HTH-MSC therapy over HTH alone. Future studies should utilise a reporting checklist such as in SYRCLE or Animal Research: Reporting of In Vivo Experiments (ARRIVE) guidelines to improve reporting standards. Impact: Very few articles investigating the use of MSCs for the treatment of hypoxic-ischaemic encephalopathy are clinically relevant. Continuing to publish studies in models of hypoxic-

ischaemic encephalopathy without the inclusion of HTH therapy does not progress the field towards improved clinical outcomes. This study shows that HTH and MSC therapy improves measures of astrogliosis. More studies are required to establish the efficacy of HTH and MSCs on measures of neuropathology and neurobehavior. The reporting of preclinical data in this space could be improved by using reporting checklists such as the SYRCLE or ARRIVE tools.

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