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## Interventions and Management

### 1. Assessment of bilateral motor skills and visuospatial attention in children with perinatal stroke using a robotic object hitting task.

Hawe RL, Kuczynski AM, Kirton A, Dukelow SP.

J Neuroeng Rehabil. 2020 Feb 13;17(1):18. doi: 10.1186/s12984-020-0654-1.

**BACKGROUND:** While motor deficits are the hallmark of hemiparetic cerebral palsy, children may also experience impairments in visuospatial attention that interfere with participation in complex activities, including sports or driving. In this study, we used a robotic object hitting task to assess bilateral sensorimotor control and visuospatial skills in children with hemiparesis due to perinatal arterial ischemic stroke (AIS) or periventricular venous infarct (PVI). We hypothesized that performance would be impaired bilaterally and be related to motor behavior and clinical assessment of visuospatial attention. **METHODS:** Forty-nine children with perinatal stroke and hemiparetic cerebral palsy and 155 typically developing (TD) children participated in the study. Participants performed a bilateral object hitting task using the KINARM Exoskeleton Robot, in which they used virtual paddles at their fingertips to hit balls that fell from the top of the screen with increasing speed and frequency over 2.3 min. We quantified performance across 13 parameters including number of balls hit with each hand, movement speed and area, biases between hands, and spatial biases. We determined normative ranges of performance accounting for age by fitting 95% prediction bands to the TD children. We compared parameters between TD, AIS, and PVI groups using ANCOVAs accounting for age effects. Lastly, we performed regression analysis between robotic and clinical measures. **RESULTS:** The majority of children with perinatal stroke hit fewer balls with their affected arm compared to their typically developing peers. We also found deficits with the ipsilesional ("unaffected") arm. Children with AIS had greater impairments than PVI. Despite hitting fewer balls, we only identified 18% of children as impaired in hand speed or movement area. Performance on the Behavioral Inattention Test accounted for 21-32% of the variance in number of balls hit with the unaffected hand. **CONCLUSIONS:** Children with perinatal stroke-induced hemiparetic cerebral palsy may have complex bilateral deficits reflecting a combination of impairments in motor skill and visuospatial attention. Clinical assessments and interventions should address the interplay between motor and visuospatial skills.

PMID: [32054511](https://pubmed.ncbi.nlm.nih.gov/32054511/)

### 2. Effect of motor imagery combined with physical practice on upper limb rehabilitation in children with hemiplegic cerebral palsy.

Souto DO, Flores Cruz TK, Coutinho K, Julio-Costa A, Fontes PLB, Haase VG.

NeuroRehabilitation. 2020 Feb 3. doi: 10.3233/NRE-192931. [Epub ahead of print]

**INTRODUCTION:** Evidence indicates that motor deficits in hemiplegic cerebral palsy (HCP) impair both motor execution and planning. However, current rehabilitation efforts focus mainly on relieving impairments in motor execution. Motor

imagery (MI) is a promising method for stimulating neural networks underlying the planning and control of movements. **OBJECTIVE:** Evaluate the effectiveness of MI combined with physical practice in improving the function of the upper limbs in children with HCP. **METHOD:** Twenty-four participants, aged 7-14 years were divided into two groups: intervention group (IG) and control group (CG). The IG was subjected to MI training and physical practice twice a week for eight consecutive weeks, while the CG received conventional therapy. Participants were assessed with the Assisting Hand Assessment (AHA) at pre-intervention, post-intervention, and follow up. **RESULTS:** The results showed improved motor functions in both groups. Analysis using the general linear model (analysis of covariance) and Bonferroni post hoc tests showed significant improvements from pre-intervention to post-intervention in the AHA for the IG. The CG showed non-significant improvement in AHA scores. **CONCLUSIONS:** These findings suggest that the MI training, combined with the physical practice program used in this study, was effective in improving upper limb function in children with HCP.

PMID: [32039870](#)

### **3. Home Programme to Improve Hand Function for Children with Bilateral Cerebral Palsy: Beneficial but Challenging.** Smidt KB, Klevberg GL, Oftedal BF.

Phys Occup Ther Pediatr. 2020 Feb 10:1-13. doi: 10.1080/01942638.2020.1711842. [Epub ahead of print]

**Aim:** To explore parents' and occupational therapists' experiences with a home program using goal-directed training to improve hand function in daily activities for children with bilateral cerebral palsy. **Methods:** The study had a qualitative exploratory design that included two focus group interviews. One group consisted of five parents, the other of three occupational therapists. Data were analyzed by qualitative content analysis. The intervention consisted of daily goal-directed training, with a dose of 25-33 hours for eight weeks. Weekly visits from the occupational therapists were provided. **Results:** Three themes were identified; 1) Home training promotes parent awareness and the child's mastery, 2) Home training is challenging and exhausting over time, and 3) Parent support is necessary, and the child's involvement is important. The parents reported improvements in the children's use of hands in daily activities. **Conclusion:** The findings indicate that the home program was beneficial but challenging, and that motivation is a key factor for implementing home-based intervention. Ongoing support to the parents, as well as strengthening the children's involvement may enhance motivation. Future research should focus on developing strategies to increase motivation, and on exploring a "hybrid" model for home training divided between home and kindergarten or school.

PMID: [32037943](#)

### **4. Brain activation patterns underlying upper limb bilateral motor coordination in unilateral cerebral palsy: an fNIRS study.**

de Campos AC, Sukal-Moulton T, Huppert T, Alter K, Damiano DL.

Dev Med Child Neurol. 2020 Feb 7. doi: 10.1111/dmcn.14458. [Epub ahead of print]

**AIM:** To explore cortical activation during bimanual tasks and functional correlates in unilateral cerebral palsy (CP). **METHOD:** This cross-sectional study included eight participants with unilateral CP (six females, two males; mean age [SD] 20y 10mo [5y 10mo], 13y 8mo-31y 6mo) in Manual Ability Classification System levels II to III and nine age-matched participants with typical development (seven females, two males; mean age [SD] 17y 8mo [5y 7mo], 9y 4mo-24y 2mo). They performed bimanual symmetric squeezing (BSS) and bimanual asymmetric squeezing (BAS) tasks at 1Hz, and a pouring task with dominant hand (DPour) and a pouring task with non-dominant hand (NDPour) at 0.67Hz, all while a custom array of functional near-infrared spectroscopy (fNIRS) optodes were placed over their sensorimotor area. Mixed-effects were used to contrast groups, tasks, and hemispheres (corrected p-values [q] reported). Analysis of variance and t-tests compared performance measures across groups and tasks. **RESULTS:** Participants with unilateral CP showed greater activation in both hemispheres during BAS (non-lesioned:  $q < 0.001$ ; lesioned:  $q < 0.001$ ), and in the lesioned hemisphere during BSS ( $q < 0.001$ ), DPour ( $q = 0.02$ ), and NDPour ( $q = 0.02$ ) than those with typical development. The lesioned hemisphere in unilateral CP showed more activity than the non-lesioned one (BSS:  $q = 0.01$ ; BAS:  $q = 0.009$ ; NDPour:  $q = 0.04$ ). During BAS, higher cortical activity correlated with more synchronous arm activation ( $r = 0.79$ ;  $p = 0.02$ ); activity lateralized towards the non-lesioned hemisphere correlated with better Pediatric Evaluation of Disability Inventory computer adaptive test scores ( $r = 0.81$ ;  $p = 0.03$ ). **INTERPRETATION:** Results suggest abnormally increased sensorimotor cortical activity in unilateral CP, with implications to be investigated. **WHAT THIS PAPER ADDS:** Cortical activity in manual tasks is described with functional near-infrared spectroscopy in typical and atypical cohorts. Activation levels in unilateral cerebral palsy appear to escalate with task

difficulty. Increased brain activity may be associated with poorer selective manual control. Specific patterns of brain activity may be related to impaired bimanual function.

PMID: [32034770](#)

### **5. Reliability of a radiation-free, noninvasive and computer-assisted assessment of the spine in children with cerebral palsy.**

Ruthard K, Raabe-Oetker A, Ruthard J, Oppermann T, Duran I, Schönau E.

Eur Spine J. 2020 Feb 8. doi: 10.1007/s00586-020-06328-4. [Epub ahead of print]

**PURPOSE:** The radiation-free, noninvasive and computer-assisted Spinal Mouse® (SM) is a reliable and valid measuring instrument for functional analysis of the pediatric spine. The aim of this study was to examine the intra-rater reliability of the SM measurements in children with cerebral palsy (CP) and to investigate differences after a 1 week of the rehabilitation program. **METHODS:** A total of 168 SM investigations in the sagittal plane and frontal plane at three measurement times from a sample of 28 children (n = 10 girls, age 9.7 ± 3.1 years) with CP were eligible for evaluation. For the verification of reliability, the measurement results from the first and second measurement times (t1, t2) were used at intervals of 1 day. In addition, differences after the rehabilitation program the patients underwent (t3) were evaluated using the measurement results of the first and third measurements (5-day interval). **RESULTS:** The results show good to excellent intra-rater reliability for the SM measurements, both in the sagittal and in the frontal plane (ICC values = 0.69-0.99). Furthermore, significant changes may occur after only 1 week of therapeutic intervention for total spinal inclination (t1: 12.82 ± 5.40, t3: 11.11 ± 5.60, p = 0.014, Cohen's d = 0.43) and spine length (t1: 401.75 ± 69.05, t3: 409.25 ± 63.58, p = 0.030, Cohen's d = 0.43). **CONCLUSIONS:** SM can be used to generate reliable values for functional analysis of the spine in children with CP. Furthermore, significant posture differences can be demonstrated by therapeutic interventions, especially in the spine inclination (Inc) and spine length (SL). These slides can be retrieved under Electronic Supplementary Material.

PMID: [32036426](#)

### **6. Benefits of a Dance Intervention on Balance in Adolescents with Cerebral Palsy.**

Cherriere C, Martel M, Sarrasin A, Ballaz L, Tallet J, Lemay M.

Phys Occup Ther Pediatr. 2020 Feb 14:1-16. doi: 10.1080/01942638.2020.1720053. [Epub ahead of print]

**Aims:** Cerebral palsy (CP) impacts motor functions such as balance, limits of stability and walking, and may also affect other functions such as attention and rhythm production. Motor and non-motor deficits lead to difficulties in daily life activities. The main objective of this study was to evaluate the effects of a dance intervention on balance in adolescents with CP. The secondary objectives were to evaluate the effects of this intervention on walking speed, attention, and rhythm production. **Methods:** A pre-post design study with a double baseline was conducted on ten adolescents with CP in order to assess the effects of a 10-week dance intervention. The dance intervention focused on improving balance and limits of stability. Outcomes on static and dynamic balance were evaluated with clinical and laboratory tests before and after the intervention. Walking speed, attention, and rhythm production were also evaluated before and after the intervention. **Results:** Balance improved after the dance intervention as assessed with both the clinical tests and a laboratory test. Rhythm production also improved after the dance intervention. **Conclusions:** Results suggest that a 10-week dance intervention is an effective activity to improve static and dynamic balance as well as rhythmic production in adolescents with CP.

PMID: [32054380](#)

### **7. Pre-treatment EMG can be used to model post-treatment muscle coordination during walking in children with cerebral palsy.**

Pitto L, van Rossom S, Desloovere K, Molenaers G, Huenaerts C, De Groote F, Jonkers I.

PLoS One. 2020 Feb 12;15(2):e0228851. doi: 10.1371/journal.pone.0228851. eCollection 2020.

When treating children with Cerebral Palsy (CP), computational simulations based on musculoskeletal models have a great potential in assisting the clinical decision-making process towards the most promising treatments. In particular, predictive simulations could be used to predict and compare the functional outcome of a series of candidate interventions. In order to be able to benefit from these predictive simulations however, it is important to know how much information about the post-treatment patient's motor control could be gathered from data available before the intervention. Within this paper, we quantified how much of the muscle activity measured after a treatment could be explained by subject-specific muscle synergies computed from EMG data collected before the intervention. We also investigated whether generic synergies could be used, in case no EMG data is available when running predictive simulations, to reproduce both pre- and post-treatment muscle activity in children with CP. Subject-specific synergies proved to be a good indicator of the patient's post-treatment motor control, explaining on average more than 85% of the post-treatment muscle activity, compared to an average of 94% when applied to the original pre-treatment data. Generic synergies explained 84% of the pre-treatment and 83% of the post-treatment muscle activity on average, but performed relatively well for patients with low selective motor control and poorly in patients with more selectivity. Our results suggest that subject-specific muscle synergies computed from pre-treatment EMG data could be used with confidence to represent the post-treatment motor control of children with CP during walking. In addition, when performing simulations involving patients with a low selective motor control, generic synergies could be a valid alternative.

PMID: [32050002](#)

### **8. Comparison of gait characteristics between clinical and daily life settings in children with cerebral palsy.**

Carcreff L, Gerber CN, Paraschiv-Ionescu A, De Coulon G, Newman CJ, Aminian K, Armand S.

Sci Rep. 2020 Feb 7;10(1):2091. doi: 10.1038/s41598-020-59002-6.

Gait assessments in standardized settings, as part of the clinical follow-up of children with cerebral palsy (CP), may not represent gait in daily life. This study aimed at comparing gait characteristics in laboratory and real life settings on the basis of multiple parameters in children with CP and with typical development (TD). Fifteen children with CP and 14 with TD wore 5 inertial sensors (chest, thighs and shanks) during in-laboratory gait assessments and during 3 days of daily life. Sixteen parameters belonging to 8 distinct domains were computed from the angular velocities and/or accelerations. Each parameter measured in the laboratory was compared to the same parameter measured in daily life for walking bouts defined by a travelled distance similar to the laboratory, using Wilcoxon paired tests and Spearman's correlations. Most gait characteristics differed between both environments in both groups. Numerous high correlations were found between laboratory and daily life gait parameters for the CP group, whereas fewer correlations were found in the TD group. These results demonstrated that children with CP perform better in clinical settings. Such quantitative evidence may enhance clinicians' understanding of the gap between capacity and performance in children with CP and improve their decision-making.

PMID: [32034244](#)

### **9. Walking Performance, Physical Activity, and Validity of the Early Activity Scale for Endurance in Young Children with Cerebral Palsy.**

Wentz EE, Bjornson KF, Kerfeld CI, Cicirello N, Fiss AL.

Phys Occup Ther Pediatr. 2020 Feb 11:1-14. doi: 10.1080/01942638.2020.1720055. [Epub ahead of print]

**Aims:** To describe the walking performance and physical activity of children with cerebral palsy (CP) by Gross Motor Function Classification System (GMFCS) level, age, sex, and geographical location; and, to examine the concurrent validity of the 4-item Early Activity Scale for Endurance (EASE) to walking performance and physical activity scores. **Methods:** Seventy-nine children with CP participated. Parents completed the 4-item EASE. All children wore an Actigraph monitor (n = 79), and children in GMFCS levels I - III also wore a StepWatch monitor (n = 50), for seven days. **Results:** Only GMFCS level yielded significant differences in average strides taken per day, in strides per day taken faster than 30 strides per minute, in average physical activity counts per minute, and in minutes per day spent in moderate to vigorous physical activity. The 4-item EASE findings were moderately correlated with average physical activity counts per minute (.61,  $p < .001$ ) and minutes per day spent in moderate to vigorous physical activity (.62,  $p < .001$ ). **Conclusions:** GMFCS level is predictive of both walking performance and physical activity in children with CP. The 4-item EASE may provide a quick and valid way to monitor physical activity in children with CP.

PMID: [32046563](#)

#### **10. Neuropsychological and neurophysiological aspects of brain-computer-interface (BCI)-control in paralysis.**

Chaudhary U, Mrachacz-Kersting N, Birbaumer N.

J Physiol. 2020 Feb 11. doi: 10.1113/JP278775. [Epub ahead of print]

Brain-computer interfaces (BCIs) aim to facilitate paralyzed patients to interact with their environment by controlling external devices using brain activity, thereby bypassing the dysfunctional motor system. Some neuronal disorders, such as amyotrophic lateral sclerosis (ALS), severely impairs the communication capacity of patients. Several invasive and non-invasive brain-computer interfaces (BCIs), most notably using electroencephalography (EEG), have been developed to provide a means of communication to paralyzed patients. However, except for a few reports, all available BCI- literature in the paralyzed (mostly ALS patients) describes patients with intact eye movement control, i.e. patients in a locked-in state (LIS) but not completely locked-in state (CLIS). In this article we will discuss: 1) The fundamental neuropsychological learning factors and neurophysiological factors determining BCI performance in clinical applications; 2) We define the difference between LIS and CLIS; 3) Recent development in the BCIs for communication in complete locked-in state patients; 4) Effect of BCI based communication on emotional well-being and quality of life; and 5) An outlook and the methodology needed to provide a means of communication to patients who have none. Thus, we present an overview of the available studies and recent results and try to anticipate future developments which may open new doors for BCI communication with the completely paralyzed. This article is protected by copyright. All rights reserved.

PMID: [32045022](#)

#### **11. Precision neuroimaging in cerebral palsy: are we there yet?**

Mankad K.

Dev Med Child Neurol. 2020 Feb 11. doi: 10.1111/dmcn.14482. [Epub ahead of print]

PMID: [32043566](#)

#### **12. The Bangladesh Cerebral Palsy Register: the value of surveillance.**

Bedard T.

Dev Med Child Neurol. 2020 Feb 11. doi: 10.1111/dmcn.14479. [Epub ahead of print]

PMID: [32043564](#)

#### **13. Functional outcomes at 2 years of age following treatment for posthemorrhagic hydrocephalus of prematurity: what do we know at the time of consult?**

McCluggage SG, Laskay NMB, Donahue BN, Arynchyna A, Zimmerman K, Aban IB, Alford EN, Peralta-Carcelen M, Blount JP, Rozzelle CJ, Johnston JM, Rocque BG.

J Neurosurg Pediatr. 2020 Feb 14:1-9. doi: 10.3171/2019.12.PEDS19381. [Epub ahead of print]

**OBJECTIVE:** Posthemorrhagic hydrocephalus of prematurity remains a significant problem in preterm infants. In the literature, there is a scarcity of data on the early disease process, when neurosurgeons are typically consulted for recommendations on treatment. Here, the authors sought to evaluate functional outcomes in premature infants at 2 years of age following treatment for posthemorrhagic hydrocephalus. Their goal was to determine the relationship between factors identifiable at the time of the

initial neurosurgical consult and outcomes of patients when they are 2 years of age. **METHODS:** The authors performed a retrospective chart review of premature infants treated for intraventricular hemorrhage (IVH) of prematurity (grade III and IV) between 2003 and 2014. Information from three time points (birth, first neurosurgical consult, and 2 years of age) was collected on each patient. Logistic regression analysis was performed to determine the association between variables known at the time of the first neurosurgical consult and each of the outcome variables. **RESULTS:** One hundred thirty patients were selected for analysis. At 2 years of age, 16% of the patients had died, 88% had cerebral palsy/developmental delay (CP), 48% were nonverbal, 55% were nonambulatory, 33% had epilepsy, and 41% had visual impairment. In the logistic regression analysis, IVH grade was an independent predictor of CP ( $p = 0.004$ ), which had an estimated probability of occurrence of 74% in grade III and 96% in grade IV. Sepsis at or before the time of consult was an independent predictor of visual impairment ( $p = 0.024$ ), which had an estimated probability of 58%. IVH grade was an independent predictor of epilepsy ( $p = 0.026$ ), which had an estimated probability of 18% in grade III and 43% in grade IV. The IVH grade was also an independent predictor of verbal function ( $p = 0.007$ ), which had an estimated probability of 68% in grade III versus 41% in grade IV. A higher weeks gestational age (WGA) at birth was an independent predictor of the ability to ambulate ( $p = 0.0014$ ), which had an estimated probability of 15% at 22 WGA and up to 98% at 36 WGA. The need for oscillating ventilation at consult was an independent predictor of death before 2 years of age ( $p = 0.001$ ), which had an estimated probability of 42% in patients needing oscillating ventilation versus 13% in those who did not. **CONCLUSIONS:** IVH grade was consistently an independent predictor of functional outcomes at 2 years. Gestational age at birth, sepsis, and the need for oscillating ventilation may also predict worse functional outcomes.

PMID: [32059191](#)

#### **14. Pressure Ulcer Risk Factors in Persons with Mobility-Related Disabilities.**

Sprigle S, McNair D, Sonenblum S.

Adv Skin Wound Care. 2020 Mar;33(3):146-154. doi: 10.1097/01.ASW.0000653152.36482.7d.

**OBJECTIVE:** To assess pressure ulcer (PU) risk in persons with mobility impairments using a large data set to identify demographic, laboratory, hemodynamic, and pharmacologic risk factors. **METHODS:** The cohort of interest was persons with disabilities who have mobility impairments and are diagnostically at risk of PUs. To define this cohort, diagnoses that qualify patients for skin protection wheelchair cushions were used. Data were obtained from the Cerner Health Facts data warehouse. Two cohorts were defined: persons with and without a history of PUs. Analysis included descriptive statistics and multivariate logistic regression modeling. Variables retained in the model were identified using LASSO, gradient boosting, and Bayesian model averaging. **MAIN RESULTS:** The resulting cohorts included more than 87,000 persons with a history of PUs and more than 1.1 million persons who did not have a PU. The data revealed seven disability groups with the greatest prevalence of PUs: those with Alzheimer disease, cerebral palsy, hemiplegia, multiple sclerosis, paraplegia/quadruplegia, Parkinson disease, and spina bifida. Ulcers in the pelvic region accounted for 82% of PUs. Persons with disabilities who were male or black had a greater prevalence of PUs. Physiologic risk factors included the presence of kidney or renal disease, decreased serum albumin, and increased serum C-reactive protein. **CONCLUSIONS:** The results indicate that, although persons with disabilities can exhibit a wide functional range, they remain at risk of PUs and should be evaluated for proper preventive measures, including support surfaces and wheelchair cushions.

PMID: [32058440](#)

#### **15. High levels of vitamin B12 are fairly common in children with cerebral palsy.**

Stenberg R, Böttiger A, Nilsson TK.

Acta Paediatr. 2020 Feb 13. doi: 10.1111/apa.15195. [Epub ahead of print]

PMID: [32056285](#)

#### **16. Cerebral Palsy: An Overview.**

Vitrikas K, Dalton H, Breish D.

Am Fam Physician. 2020 Feb 15;101(4):213-220.

Cerebral palsy, which occurs in two to three out of 1,000 live births, has multiple etiologies resulting in brain injury that affects movement, posture, and balance. The movement disorders associated with cerebral palsy are categorized as spasticity, dyskinesia, ataxia, or mixed/other. Spasticity is the most common movement disorder, occurring in 80% of children with cerebral palsy. Movement disorders of cerebral palsy can result in secondary problems, including hip pain or dislocation, balance problems, hand dysfunction, and equinus deformity. Diagnosis of cerebral palsy is primarily clinical, but magnetic resonance imaging can be helpful to confirm brain injury if there is no clear cause for the patient's symptoms. Once cerebral palsy has been diagnosed, an instrument such as the Gross Motor Function Classification System can be used to evaluate severity and treatment response. Treatments for the movement disorders associated with cerebral palsy include intramuscular onabotulinumtoxinA, systemic and intrathecal muscle relaxants, selective dorsal rhizotomy, and physical and occupational therapies. Patients with cerebral palsy often also experience problems unrelated to movement that need to be managed into adulthood, including cognitive dysfunction, seizures, pressure ulcers, osteoporosis, behavioral or emotional problems, and speech and hearing impairment.

PMID: [32053326](#)

### **17. Essence of the Bobath concept in the treatment of children with cerebral palsy. A qualitative study of the experience of Spanish therapists.**

Farjoun N, Mayston M, Florencio LL, Fernández-De-Las-Peñas C, Palacios-Ceña D.

Physiother Theory Pract. 2020 Feb 11:1-13. doi: 10.1080/09593985.2020.1725943. [Epub ahead of print]

Objective: The aim was to explore the experiences of a group of Spanish physical therapists who apply the Bobath concept in the treatment of children with cerebral palsy, specifically to identify the components they experience as core and essential to the Bobath concept. Design: A qualitative phenomenological study. Methods: This study used purposive sampling. Non-structured interviews were carried out with 10 Spanish Bobath-trained physical therapists who treat children with cerebral palsy. Thematic analysis was applied. Results: Five themes regarding the essence of the Bobath concept emerged: 1) "normal movement" as a guide; 2) a "global" concept; 3) observation; 4) the centrality of tone; and 5) working with families. Within these themes, additional principles were reflected cross-sectionally, such as therapy being a continuous process of assessment and treatment, the application of principles of motor learning, and the importance of carryover of treatment into function. Conclusions: The results demonstrated themes traditionally identified as core to the Bobath concept, including working with families, which is also considered integral to the approach. The study participants used outdated terminology at times when discussing tone and movement. However, they reported that they no longer adhere to the theoretical perspective of pathological reflexes and reflex/tone inhibition. This study provides insight into how treatment of children with cerebral palsy based on the Bobath concept is experienced by a group of Spanish physiotherapists, who identified five main themes that they perceive as essential. The results provide grounds for further research into the application of the Bobath concept in children.

PMID: [32043397](#)

### **18. Parent and Clinician Perspectives on the Participation of Children with Cerebral Palsy in Community-Based Football: A Qualitative Exploration in a Regional Setting.**

Sivaratnam C, Howells K, Stefanac N, Reynolds K, Rinehart N.

Int J Environ Res Public Health. 2020 Feb 10;17(3). pii: E1102. doi: 10.3390/ijerph17031102.

The current study aimed to qualitatively explore parent and clinician perspectives on the factors influencing participation in a community-based Australian-Rules Football program for five to 12-year-old children with cerebral palsy (CP) in a regional setting. Six allied-health clinicians and two parents of children with CP participated in focus groups exploring factors influencing participation. Thematic analysis indicated seven key factors influencing participation-of which, six were environmental factors and one was related to child characteristics. Environmental factors included resources, communication, knowledge and previous experience, attitudes and expectations, game factors and community relevance. Child characteristics included age, preferences, confidence, as well as cognitive and physical functioning. Notwithstanding limitations, the current study highlights the central role of 'people factors' in the child's environment, in facilitating participation in community-based physical activity.

PMID: [32050514](#)

**19. Cerebral palsy in Canada, 2011-2031: results of a microsimulation modelling study of epidemiological and cost impacts. [Article in English, French; Abstract available in French from the publisher]**

Amankwah N, Oskoui M, Garner R, Bancej C, Manuel DG, Wall R, Finès P, Bernier J, Tu K, Reimer K.

Health Promot Chronic Dis Prev Can. 2020 Feb;40(2):25-37. doi: 10.24095/hpcdp.40.2.01.

**INTRODUCTION:** The objective of our study was to present model-based estimates and projections on current and future health and economic impacts of cerebral palsy in Canada over a 20-year time horizon (2011-2031). **METHODS:** We used Statistics Canada's Population Health Model (POHEM)-Neurological to simulate individuals' disease states, risk factors and health determinants and to describe and project health outcomes, including disease incidence, prevalence, life expectancy, health-adjusted life expectancy, health-related quality of life and health care costs over the life cycle of Canadians. Cerebral palsy cases were identified from British Columbia's health administrative data sources. A population-based cohort was then used to generate the incidence and mortality rates, enabling the projection of future incidence and mortality rates. A utility-based measure (Health Utilities Index Mark 3) was also included in the model to reflect various states of functional health to allow projections of health-related quality of life. Finally, we estimated caregiving parameters and health care costs from Canadian national surveys and health administrative data and included them as model parameters to assess the health and economic impact of cerebral palsy. **RESULTS:** Although the overall crude incidence rate of cerebral palsy is projected to remain stable, newly diagnosed cases of cerebral palsy will rise from approximately 1800 in 2011 to nearly 2200 in 2031. In addition, the number of people with the condition is expected to increase from more than 75 000 in 2011 to more than 94 000 in 2031. Direct health care costs in constant 2010 Canadian dollars were about \$11 700 for children with cerebral palsy aged 1-4 years versus about \$600 for those without the condition. In addition, people with cerebral palsy tend to have longer periods in poorer health-related quality of life. **CONCLUSION:** Individuals with cerebral palsy will continue to face challenges related to an ongoing need for specialized medical care and a rising need for supportive services. Our study offers important insights into future costs and impacts associated with cerebral palsy and provides valuable information that could be used to develop targeted health programs and strategies for Canadians living with this condition. **PLAIN-LANGUAGE-SUMMARY:** A cerebral palsy diagnosis is accompanied by a substantial economic and social burden. The number of newly diagnosed cases of cerebral palsy will rise from approximately 1800 in 2011 to nearly 2200 in 2031. The number of people living with cerebral palsy is expected to increase from more than 75 000 in 2011 to more than 94 000 in 2031. Canadians with cerebral palsy will continue to experience reduced quality of life, increased disabilities and a rising need for supportive services including in formal care.

PMID: [32049464](#)

**20. QUALITY OF LIFE IN CAREGIVERS OF PEDIATRIC PATIENTS WITH CEREBRAL PALSY AND GASTROSTOMY TUBE FEEDING.**

Figueiredo AA, Lomazi EA, Montenegro MA, Bellomo-Brandão MA.

Arq Gastroenterol. 2020 Feb 10. pii: S0004-28032020005001201. doi: 10.1590/S0004-2803.202000000-02. [Epub ahead of print]

**BACKGROUND:** Cerebral palsy is the most common cause of physical disability in childhood. Caregivers of patients presenting tetraparesis cerebral palsy (TCP) and gastrostomy tube feeding (GTF) were selected for this study because both conditions represent a great demand for their caregivers. **OBJECTIVE:** To describe the quality of life related to the state of health of caregivers of patients with TCP who were fed by gastrostomy, to assess the results linked to the mental health of these caregivers, to compare our data with data from other studies on children with cerebral palsy without gastrostomy and to evaluate the possible interference of gastrostomy in the quality of life. **METHODS:** A number of 30 major caregivers were interviewed and assessed. Quality of life and mental health tools applied and analyzed only for caregivers were: Medical Outcomes Study (MOS) 36-item Short Form Health Survey (SF-36), WHOQOL-BREF and Beck scales. Other information (age, gender, marital status, number of residents per household and psychological support) was evaluated. The Spearman's rank correlation coefficient was used to analyze. A 5% significance level was adopted. **RESULTS:** Results obtained through questionnaires are as follows: moderate hopelessness in 20% of caregivers (the higher the number of residents per household the higher the level of caregiver's hopelessness); moderate and severe anxiety in 33.33% of the sample studied; moderate and severe depression identified in 46.67% of interviewed caregivers; health-related quality of life of caregivers of patients with

TCP were found to be below world averages; no significant figures for suicide potential were noted for the population under this study. **CONCLUSION:** The HRQOL of caregivers of TCP patients who were fed by gastrostomy is below the average of the general population. Our results are very similar to those found in other studies that evaluated caregivers of patients with cerebral palsy with different degrees of neurological impairment and no report of using GTF, suggesting that the presence of gastrostomy did not negatively interfere with the caregiver's HRQOL.

PMID: [32049188](#)

## **21. Both ADP-Ribosyl-Binding and Hydrolase Activities of the Alphavirus nsP3 Macrodomein Affect Neurovirulence in Mice.**

Abraham R, McPherson RL, Dasovich M, Badiee M, Leung AKL, Griffin DE.

mBio. 2020 Feb 11;11(1). pii: e03253-19. doi: 10.1128/mBio.03253-19.

Macrodomein (MD), a highly conserved protein fold present in a subset of plus-strand RNA viruses, binds to and hydrolyzes ADP-ribose (ADPr) from ADP-ribosylated proteins. ADPr-binding by the alphavirus nonstructural protein 3 (nsP3) MD is necessary for the initiation of virus replication in neural cells, whereas hydrolase activity facilitates replication complex amplification. To determine the importance of these activities for pathogenesis of alphavirus encephalomyelitis, mutations were introduced into the nsP3 MD of Sindbis virus (SINV), and the effects on ADPr binding and hydrolase activities, virus replication, immune responses, and disease were assessed. Elimination of ADPr-binding and hydrolase activities (G32E) severely impaired in vitro replication of SINV in neural cells and in vivo replication in the central nervous systems of 2-week-old mice with reversion to wild type (WT) (G) or selection of a less compromising change (S) during replication. SINV with decreased binding and hydrolase activities (G32S and G32A) or with hydrolase deficiency combined with better ADPr-binding (Y114A) were less virulent than WT virus. Compared to the WT, the G32S virus replicated less well in both the brain and spinal cord, induced similar innate responses, and caused less severe disease with full recovery of survivors, whereas the Y114A virus replicated well, induced higher expression of interferon-stimulated and NF- $\kappa$ B-induced genes, and was cleared more slowly from the spinal cord with persistent paralysis in survivors. Therefore, MD function was important for neural cell replication both in vitro and in vivo and determined the outcome from alphavirus encephalomyelitis in mice. **IMPORTANCE** Viral encephalomyelitis is an important cause of long-term disability, as well as acute fatal disease. Identifying viral determinants of outcome helps in assessing disease severity and developing new treatments. Mosquito-borne alphaviruses infect neurons and cause fatal disease in mice. The highly conserved macrodomein of nonstructural protein 3 binds and can remove ADP-ribose (ADPr) from ADP-ribosylated proteins. To determine the importance of these functions for virulence, recombinant mutant viruses were produced. If macrodomein mutations eliminated ADPr-binding or hydrolase activity, viruses did not grow. If the binding and hydrolase activities were impaired, the viruses grew less well than the wild-type virus, induced similar innate responses, and caused less severe disease, and most of the infected mice recovered. If binding was improved, but hydrolase activity was decreased, the virus replicated well and induced greater innate responses than did the WT, but clearance from the nervous system was impaired, and mice remained paralyzed. Therefore, macrodomein function determined the outcome of alphavirus encephalomyelitis.

PMID: [32047134](#)

## **22. Real-time Monitoring of Hypoxic-Ischemic Brain Damage in Neonatal Rats Using Diffuse Light Reflectance Spectroscopy.**

Kinoshita S, Kawauchi S, Nagamatsu T, Nishidate I, Fujii T, Sato S.

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Obstetric management to prevent hypoxic ischemic encephalopathy (HIE) during labor is important to reduce the cerebral palsy incidence in neonates. A novel approach to monitor or predict fetal brain damage during labor is required. Diffuse reflectance spectroscopy is a noninvasive method routinely used to assess the intrinsic characteristics of tissues. This study investigated the time course of diffuse reflectance signals during an early stage of cerebral cortical damage in a neonatal rat HIE model (Vannucci's model). In the model, an HIE lesion was induced by hypoxic exposure following ligation of the left common carotid artery. Using this model, we established an experimental system to detect diffuse light reflectance signals at time points of interest. Quantitative monitoring of total hemoglobin, oxygen saturation, and scattering amplitude was conducted to examine the basis of the diffused reflectance signals. During hypoxic exposure, which induced HIE damage in the left hemisphere after ligation, the oxygen saturation level decreased, but the difference between the two hemispheres was relatively small. During

this period, total hemoglobin was increased in both hemispheres, but the change in the left hemisphere was significantly greater than that in the right, which is attributable to a vigorous compensation response. During hypoxia, scattering amplitude, which reflects cellular/subcellular morphology, revealed a remarkable difference between the two hemispheres. We confirmed that scattering amplitude levels negatively correlated with the extent of edema. These findings suggest that simultaneous monitoring of the scattering amplitude, in addition to hemodynamic parameters, is useful for detecting brain tissue alterations leading to HIE.

PMID: [32046394](#)

### **23. Mortality and Neurodevelopmental Outcomes in the Heart Rate Characteristics Monitoring Randomized Controlled Trial.**

Schelonka RL, Carlo WA, Bauer CR, Peralta-Carcelen M, Phillips V, Helderman J, Navarrete CT, Moorman JR, Lake DE, Kattwinkel J, Fairchild KD, O'Shea TM.

J Pediatr. 2020 Feb 4. pii: S0022-3476(19)31745-7. doi: 10.1016/j.jpeds.2019.12.066. [Epub ahead of print]

**OBJECTIVE:** To test whether the composite outcome of death or neurodevelopmental impairment (NDI) at 18-22 months corrected age for infants  $\leq 1000$  g at birth is decreased by continuous monitoring of heart rate characteristics during neonatal intensive care. **STUDY DESIGN:** We studied a subset of participants enrolled in a multicenter randomized trial of heart rate characteristics monitoring. Survivors were evaluated at 18-22 months corrected age with a standardized neurologic examination and the Bayley Scales of Infant Development-III (BSID-III). NDI was defined as Gross Motor Function Classification System of  $>2$  (moderate or severe cerebral palsy), BSID-III language or cognitive scores of  $<70$ , severe bilateral hearing impairment, and/or bilateral blindness. **RESULTS:** The composite outcome, death or NDI, was obtained for 628 of 884 study infants (72%). The prevalence of this outcome was 44.4% (136/306) among controls (infants randomized to heart rate characteristics monitored but not displayed) and 38.9% (125/322) among infants randomized to heart rate characteristics monitoring displayed (relative risk, 0.87; 95% CI, 0.73-1.05;  $P = .17$ ). Mortality was reduced from 32.0% (99/307) among controls to 24.8% (81/326) among monitoring displayed infants (relative risk, 0.75; 95% CI, 0.59 to 0.97;  $P = .028$ ). The composite outcomes of death or severe CP and death or mildly low Bayley cognitive score occurred less frequently in the displayed group ( $P < .05$ ). **CONCLUSIONS:** We found no difference in the composite outcome of death or NDI for extremely preterm infants whose heart rate characteristics were and were not displayed during neonatal intensive care. Two outcomes that included mortality or a specific NDI were less frequent in the displayed group.

PMID: [32033793](#)

### **24. Status Dystonicus: A Rare Manifestation of Cerebral Palsy.**

Tyagi V, Agrawal A, Mishra D, Juneja M.

Indian J Pediatr. 2020 Feb 8. doi: 10.1007/s12098-020-03206-1. [Epub ahead of print]

PMID: [32036591](#)