Cerebral palsy research news

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Interventions and Management

1. Self-feeding kinematics in an ecological setting: typically developing children and children with cerebral palsy
Tal Krasovsky, Tal Keren-Capelovitch, Jason Friedman, Patrice L Weiss

IEEE Trans Neural Syst Rehabil Eng. 2021 Jul 19;PP. doi: 10.1109/TNSRE.2021.3098056. Online ahead of print.

Assessment of self-feeding kinematics is seldom performed in an ecological setting. In preparation for development of an instrumented spoon for measurement of self-feeding in children with cerebral palsy (CP), the current work aimed to evaluate upper extremity kinematics of self-feeding in young children with typical development (TD) and a small, age-matched group of children with CP in a familiar setting, while eating with a spoon. Methods: Sixty-five TD participants and six children diagnosed with spastic CP, aged 3-9 years, fed themselves while feeding was measured using miniature three-dimensional motion capture sensors (trakStar). Kinematic variables associated with different phases of self-feeding cycle (movement time, curvature, time to peak velocity and smoothness) were compared across age-groups in the TD sample and between TD children and those with CP. Results: Significant between-age group differences were identified in movement times, time to peak velocity and curvature. Children with CP demonstrated slower, less smooth self-feeding movements, potentially related to activity limitations. Conclusions: The identified kinematic variables form a basis for implementation of self-feeding performance assessment in children of different ages, including those with CP, which can be deployed via an instrumented spoon.

PMID: 34280104

2. Botulinum therapy of spastic forms of cerebral palsy in various locomotor patterns [Article in Russian]
D A Krasavina, A V Chemeris, O R Orlova, Y I Ivanov

Zh Nevrol Psikhiatr Im S S Korsakova. 2021;121(6):119-123. doi: 10.17116/jnevro2021121061119.

Spasticity in patients with cerebral palsy (CP) is the main impediment to normal locomotion. The function of the Central Pattern Generator (CPG), i.e. a group of neural chains in the spinal cord, stands at the core of any rhythmical movement. CPG can generate locomotion patterns without supraspinal control, which can have both positive and negative impact on the ability to move. Performing the motor tasks such as walking, running and swimming, creates the consistent rhythmical movement of legs and arms through interaction between CPGs of upper and lower extremities. This interaction can cause the activation of pathological movement patterns in lower extremities in response to upper limb spasticity. Thus, neural chains in the spinal cord become the generator of pathologically increased excitation which has developed as a result of a focal lesion in the CNS. All the statements described above show the importance of introducing the upper limb injections of botulinum toxin A in the protocol in order to develop normal locomotion. The PUL study approved the optimal level of efficacy and favourable safety profile of botulinum toxin A in children with CP and upper limb muscle spasticity.

PMID: 34283541

3. Trunk and pelvis biomechanical responses in children with cerebral palsy and with typical development during horseback riding
Taweetip Tabsuri, Nuanlaor Thawinchai, Siriporn Peansukmanee, Vipul Lugade

Gait Posture. 2021 Jul 15;89:115-119. doi: 10.1016/j.gaitpost.2021.07.006. Online ahead of print.

Background: Children with cerebral palsy (CP) have poor postural control. Horseback riding (HR) is an alternative treatment shown to improve postural control among children with CP. However, there is a paucity of research investigating the underlying mechanisms responsible for improving postural control during HR. Research question: What are the three-dimensional biomechanical responses of the trunk and pelvis during HR among children with CP and with typical development (TD)? Methods: The participants, aged 4-12 years old, were inexperienced horseback riders, consisting of 10 children with TD and 10 children with spastic diplegia CP (SDCP) with GMFCS level III. Participants donned inertial measurement units (IMU) on their trunk and pelvis in order to measure angular displacement and velocity. An additional IMU was placed on the horse's lumbosacral joint. The mean absolute relative phase (MARP) and deviation phase (DP) were calculated from each plane of movement for the angular displacement and velocity across the gait cycle of the horse. Differences between groups were analyzed using independent t-tests. Results: The MARP in the frontal plane was lower in the SDCP group, when compared to the TD group ($p = 0.01$). Additionally, no differences were found between groups for the DP along all three axes. However, the TD group demonstrated greater pelvic movement variability in relation to the horse's pelvis movement, when compared to the SDCP group. Significance: Children with SDCP demonstrated an in-phase coupling pattern with decreased variability of pelvic movement in relation to the horse's pelvis.

PMID: 34280881

4. Evaluation of psychometric properties of the segmental assessment of trunk control (SATCo) in children with spastic quadriplegic cerebral palsy
J S Tedla, R S Reddy

Observational Study Niger J Clin Pract. 2021 Jul;24(7):1077-1081. doi: 10.4103/njcp.njcp_265_20.

Background: Segmental Assessment of Trunk Control (SATCo) is a scientific evaluation measure used to assess trunk control in subjects with cerebral palsy (CP). Aims: The present study aimed at assessing the psychometric properties of SATCo in children with spastic quadriplegic CP. Methodology: This was an observational study in which we validated a test instrument in 31 children (aged 1-5 years) with spastic quadriplegic CP. Children were assessed for trunk control by principal rater (R1) using SATCo. Each assessment was video recorded, scored retrospectively, and independently by principal rater (R2) and secondary rater (R3) for intra-rater and inter-rater reliability, respectively. Concurrent validity was assessed by comparing the SATCo scores with sitting component scores of Gross Motor Functional Measure -88. Results: Intra-class correlation coefficient values for intra-rater and inter-rater reliability for various components of the scale ranged from 0.82 to 0.98. The concurrent validity was calculated for various components of the scale using the Pearson correlation coefficient and they ranged from 0.72 to 0.77. Conclusion/recommendation: SATCo is a reliable and valid scale that can be used for examining trunk control in children with spastic quadriplegic CP aged 1-5 years.

PMID: 34290186

5. Efficacy of antifibrinolytics in reducing blood loss during hip reconstruction surgery in cerebral palsy children. A systematic review and meta-analysis
Karthick Rangasamy, Deepak Neradi, Nirmal Raj Gopinathan, Komal Anil Gandhi, Praveen Sodavarapu

Review J Clin Orthop Trauma. 2021 Jun 29;20:101488. doi: 10.1016/j.jcot.2021.101488. eCollection 2021 Sep.

Background: Cerebral palsy (CP) children undergoing hip reconstruction are more prone to blood loss during surgery due to poor nutritional status, antiepileptic medication intake, depletion of clotting factors, and the extent of surgery involved. We conducted this present review to analyze whether antifibrinolytics during hip surgery in CP children would reduce surgical blood loss and transfusion requirements. Methods: Three databases (PubMed, EMBASE, and Cochrane library) were searched independently for publications mentioning the use of antifibrinolytics during hip reconstruction surgery in CP children. The primary outcome was to compare the surgical blood loss with and without antifibrinolytics use. Secondary outcomes were transfusion requirements, drop in hemoglobin level, length of hospital stay, and complication rates. Results: All five studies (reporting 478 patients) published on this topic were found eligible based on inclusion criteria and were included for final analysis. Primary outcome: In three of the included studies, antifibrinolytics use resulted in a significant reduction in total blood loss with a mean difference (MD) of -151.05 mL (95% CI -272.30 to -29.80, p = 0.01). In the other two studies although statistically not significant, antifibrinolytics use reduces estimated blood loss (MD: 3.27, 95% CI -21.44 to 14.91, p = 0.72). Secondary outcomes: We observed that in the antifibrinolytics group, there was a reduction in total blood transfusion requirements (OD: 0.70, 95% CI 0.35 to 1.37, p = 0.29), and a drop in haemoglobin level (MD: 0.16, 95% CI -0.62 to 0.30, p = 0.49) but statistically not significant. No adverse effects related directly to antifibrinolytics were noticed in all five studies. Conclusion: Only two out of five included studies favored the use of antifibrinolytics in CP children undergoing hip reconstruction. The evidence synthesized on this meta-analysis is also not sufficient enough to support its routine use in this cohort of children for hip reconstruction surgery. High-quality studies with adequate sample size to determine the effective and safe dosage, timing, and cost involved of different antifibrinolytics are the need of the hour. Level of evidence: Ⅲ.

PMID: 34277342

6. Long-term effect of botulinum toxin A on the hip and spine in cerebral palsy: A national retrospective cohort study in Taiwan

Ching-Yueh Lin, Chi-Hsiang Chung, Dennis J Matthews, Heng-Yi Chu, Liang-Cheng Chen, Sung-Sen Yang, Wu-Chien Chien

PLoS One. 2021 Jul 22;16(7):e0255143. doi: 10.1371/journal.pone.0255143. eCollection 2021.

Objectives: To investigate the effect of botulinum toxin A (BTA) on the development of hip dislocation and scoliosis, surgical rates for hip and spine, and mortality in cerebral palsy (CP). Study design: A cohort study was conducted using CP data from a Taiwan National Insurance Health Research Database. Diagnoses were defined using the International Classification of Diseases codes, 9th revision. Adjusted hazard ratios for outcomes were calculated using Cox regression analysis and adjusted for the following variables: BTA injection, sex, age, severities of CP, comorbidities, location, urbanization level, and level of care. Results: A total of 1,405 CP children (670 female vs. 735 male), 281 in the BTA group and 1,124 in the controls, were followed-up for a mean of 5 years 4 months. There were no significant differences in the outcomes in both groups, in the incidence rates of hip dislocation and scoliosis, nor in the surgical rates for hip and spine surgery. Mortality rate in the BTA group was 0.49 times lower than that in the controls (p = 0.001). Moderate to severe types of CP had higher incidence rates of hip dislocation, scoliosis, hip surgery, spine surgery, and mortality. Conclusion: Moderate to severe types of CP had poorer outcomes in all aspects, including a higher risk of hip dislocation, scoliosis, surgical rate for hip and spine, and mortality. Although BTA injection in children with CP proved to not significantly reduce hip dislocation and scoliosis, it is considered safe as an anti-spasticity treatment and may be beneficial for survival.

PMID: 34293010

7. Examination of the effects of age, sex, and motor ability level on balance capabilities in children with cerebral palsy GMFCS levels I, II, III and typical development using the Pediatric Balance Scale

Mary Rose Franjoine, Nancy Darr, Brenda Young, Sally Westcott McCoy, Alyssa LaForme Fiss

Dev Neurorehabil. 2021 Jul 20;1-10. doi: 10.1080/17518423.2021.1943033. Online ahead of print.

Purpose: Explore effects of age, sex, and motor ability level on balance capabilities in preschoolers with and without Cerebral Palsy (CP). Method: PBS was administered to 477 children 24 through 59 months: 258 with typical development (TD) and 219 with CP GMFCS levels I, II and III. Results: 3-way ANOVA indicated PBS scores were significantly affected by age ($F_{4,437}=26.95$, $p<0.0001$, $\eta 2p=0.198$), motor ability level ($F_{3,437}=482.15$, $p<0.0001$, $\eta 2p=0.768$) and sex ($F_{1,437}=4.64$, $p<0.03$, $\eta 2p=0.01$) with significant interaction between motor ability level and age ($F_{12,437}=5.25$, $p<0.001$, $\eta 2p=0.126$). Children's performance on individual items was analyzed by age, sex and motor ability level. Conclusion: Children with TD outperformed children with CP GMFCS level I 36-59 months and children with CP GMFCS levels II and III 24-59 months.

Expected performance values for children with TD and children with CP, ages 24-59 months, at GMFCS levels I, II and III are provided.

PMID: 34282712

8. Factors associated with increased terminal swing knee flexion in cerebral palsy
Colm Daly

Gait Posture. 2021 Jul 16;89:126-131. doi: 10.1016/j.gaitpost.2021.07.007. Online ahead of print.

Background: Increased terminal swing knee flexion (TSKF) impacts on step length, walking efficiency and may lead to knee flexion in stance in cerebral palsy (CP). Surgical lengthening of the hamstrings is often used to address this issue, but outcomes are inconsistent. There is an established association between TSKF and functional shortening or reduced lengthening velocity of the hamstrings. However, the aetiology of increased TSKF in CP is complex and additional associated factors are not well understood. An examination of clinical and kinematic factors associated with increased TSKF may demonstrate this complexity, highlight the multifactorial nature of this feature and provide a basis for enhanced treatment decision making. Research question: What kinematic and clinical factors are associated with TSKF in individuals with CP? Methods: A retrospective database review was conducted. Individuals with bilateral CP were identified and a subset was extracted which represented the full spectrum of degree of TSKF in the database. The total dataset for analysis was n = 88. Associations between absolute clinical and kinematic data and TSKF were explored using correlation analysis, linear and multivariate regression. Time series data were examined across quartiles using statistical parametric mapping analysis of variance (SPM ANOVA). Results: Increased TSKF was associated with overall gait impairment (GDI), degree of knee flexion throughout the stride, knee extension velocity, hamstring lengthening characteristics and functional status (GMFCS). There was no relationship to walking speed or clinical measures of hamstring extensibility on clinical assessment. Significance: TSKF is associated with multiple factors which clinicians need to consider when devising treatment strategies. Caution is advised when relying on degree of TSKF to independently guide surgical decision-making.

PMID: 34280883

9. Infants born preterm and infants born full-term generate more selective leg joint movement during the scaffolded mobile task
Jeong Ah Kim, Linda Fetters, Masayoshi Kubo, Kathryn L Havens, Sandrah P Eckel, Barbara Sargent

Infancy. 2021 Jul 20. doi: 10.1111/infa.12424. Online ahead of print.

Infants born very preterm (PT), prior to 32 weeks gestation, are at increased risk of developing cerebral palsy. Children with spastic cerebral palsy have impaired selective leg joint movement, which contributes to lifelong walking limitations. We investigated whether infants born PT generated more selective hip-knee joint movement (e.g., hip flexes as knee extends) while participating in a scaffolded mobile task. Infants born PT and infants born full-term (FT) at 4 months corrected age participated in a scaffolded mobile task for 2-3 consecutive days. The scaffolded mobile task required infants to raise their legs vertically over a virtual threshold. Three threshold heights (low, middle, and high) were used to test whether the middle and high heights encourage infants to move their legs more selectively. Fifteen infants born FT learned the task and showed more selective hip-knee movement at each of the three threshold heights on the day that they learned, compared with their baseline spontaneous kicking. Thirteen infants born PT learned the task and showed more selective hip-knee movement on their learning day, but only when the middle and high thresholds were used. The results show that the scaffolded mobile task effectively encouraged infants to generate more selective hip-knee joint movement.

PMID: 34288368

10. Intensive voice treatment (the Lee Silverman Voice Treatment [LSVT ® LOUD]) for individuals with Wilson's disease and adult cerebral palsy: two case reports
Esra Ertan, Hakan I Gürvit, Haşmet H Hanağası, Başar Bilgiç, Müge A Tunçer, Cemil Yılmaz

Logoped Phoniatr Vocol. 2021 Jul 21;1-9. doi: 10.1080/14015439.2021.1951348. Online ahead of print.

Objective: In this case report, we aimed to examine the effects of an intensive voice treatment (the Lee Silverman Voice Treatment [LSVT®LOUD]) for Wilson's disease (WD), and adult cerebral palsy (CP), and dysarthria. Method: The participants received LSVT®LOUD four times a week for 4 weeks. Acoustic, perceptual (GRBAS) analyses were performed and data from the Voice Handicap Index (VHI) were obtained before and after treatment. Results: Besides the Harmonics-to Noise Ratio (HNR) value (dB) of the participant with WD, for both participants' fundamental frequencies (Hz), jitter (%), and shimmer (%) values showed significant differences ($p < .05$) after therapy. Both participants showed significant improvements ($p < .05$) in the duration (s) and the sound pressure level (dB, SPL) of sustained vowel phonation (/a/), in SPL (dB) of pitch range (high and low /a/) and reading and conversation ($p < .01$). There was a positive improvement in the high-frequency values (Hz) of both participants but not in the low-frequency values (Hz) in the participant with WD. Perceptual analysis with GRBAS judgements of sustained vowel (/a/) and paragraph reading of two participants also showed improvement. After therapy, perceived loudness of the participants' voice increased. Conclusions: The findings provide some preliminary observations that the individuals with WD and the adult individuals with CP can respond positively to intensive speech treatment such as LSVT®LOUD. Further studies are needed to investigate speech treatments specific to WD and adult CP.

PMID: 34287100

11. Pain, fatigue, depressive symptoms and sleep disturbance in young adults with cerebral palsy
Marloes van Gorp, Annet J Dallmeijer, Leontien van Wely, Vincent de Groot, Caroline B Terwee, Gerard Flens, Henk J Stam, Wilma van der Slot, Marij E Roebroeck, PERRIN DECADE Study Group

Disabil Rehabil. 2021 Jul;43(15):2164-2171. doi: 10.1080/09638288.2019.1694998. Epub 2019 Dec 6.

Purpose: Investigate pain, fatigue, depressive symptoms and sleep disturbance in young adults with cerebral palsy compared to references. Materials and methods: Young adults with cerebral palsy (n = 97, aged 21-34 years) and age-matched references from the general population (n = 190) rated pain using a numeric rating scale and fatigue, depressive symptoms, sleep disturbance and global health using Patient-Reported Outcomes Measurement Information System® short forms. Scores were compared between cerebral palsy subgroups and the reference population. Correlation coefficients and linear regression analyses assessed interrelationships of health issues and associations with global health. Results: Individuals with Gross Motor Function Classification System level I had less pain, fatigue and depressive symptoms, while individuals with levels II and III-V had more pain (53% and 56%, $p < 0.001$) and those with levels III-V more fatigue (39%, $p = 0.035$) than references (pain: 26%, fatigue: 14%). Pain and fatigue were more interrelated (correlation coefficients: 0.71 vs. 0.41) and stronger associated with global mental health in individuals with cerebral palsy. Conclusions: Young adults with Gross Motor Function Classification System levels II-V report more pain and those with levels III-V report more fatigue than references. Pain and fatigue are highly interrelated and specifically relate to mental health in individuals with cerebral palsy. Implications for rehabilitation. Except for those in the highest level of motor function, young adults with cerebral palsy report higher levels of pain and fatigue compared to the general population of the same age. Pain and fatigue are strongly interrelated and associated with mental health in young adults with cerebral palsy. The present study recommends to monitor pain and fatigue in young adults with cerebral palsy with low levels of gross motor function. We advise rehabilitation professionals to consider combined treatment for both pain and fatigue.

PMID: 34275407

12. Depression, anxiety and stress among caregivers of adolescents with cerebral palsy in rural Bangladesh
Rosalie Power, Mohammad Muhit, Eamin Heanoy, Tasneem Karim, Claire Galea, Nadia Badawi, Gulam Khandaker

Disabil Rehabil. 2021 Jul;43(15):2123-2130. doi: 10.1080/09638288.2019.1692378. Epub 2019 Dec 6.

Purpose: Prior studies indicate high risk of mental health problems among caregivers of adolescents with cerebral palsy although limited consideration is given to caregivers in low- and middle-income countries. This study aimed to compare the burden of depression, anxiety and stress among caregivers of adolescents with cerebral palsy to caregivers of adolescents without disability in rural Bangladesh; and to identify factors unique to low- and middle-income countries that predict caregiver's mental health. Methods: Observational study comparing caregivers of adolescents with cerebral palsy identified through the Bangladesh Cerebral Palsy Register and caregivers of adolescents without disability from neighboring dwellings.

Caregiver mental health was assessed using the Depression, Anxiety and Stress Scale-21, adolescent mental health using the Strengths and Difficulties Questionnaire and adolescent health-related quality of life using Kidscreen-27. Hierarchical multivariable regression analysis was performed. Results: Participants were 154 caregivers of adolescents with cerebral palsy and 173 caregivers of adolescents without disability, matched on adolescent age and sex. Caregivers of adolescents with cerebral palsy reported significantly higher risk of depression and stress than caregivers of adolescents without disability (Effect Size 0.1 to 0.2, $p < 0.05$) although no difference on anxiety. Caregiver age, adolescent mental health, household overcrowding and adolescent hearing impairment were significant predictors of depression, anxiety and/or stress (0.1 to 2.2, $p < 0.05$). Conclusions: Caregivers of adolescents with cerebral palsy in rural Bangladesh are at high risk of depression and stress. Initiatives to improve caregiver mental health are required; we recommend initiatives address adolescent mental health problems and include poverty reduction measures to improve social and economic capital. Improved understanding of the factors predicting caregiver depression, anxiety and stress unique to low and middle-income countries are necessary to guide policies and public health infrastructure development. Implications for rehabilitation: Caregivers of adolescents with cerebral palsy in rural Bangladesh are at significantly higher risk of depression and stress than caregivers of adolescents without disability. We recommend interventions to improve caregiver mental health give specific consideration to older caregivers, those whose adolescent report mental health problems, families living in crowded households, and/or whose child has hearing impairment. We recommend interventions include poverty reduction measures to improve social and economic capital and target both caregivers and adolescents with CP to enhance long term outcomes.

PMID: 34275406

13. Cause-of-death trends among adults with and without cerebral palsy in the United States, 2013-2017
J Dalton Stevens, Margaret A Turk, Scott D Landes

Ann Phys Rehabil Med. 2021 Jul 14;101553. doi: 10.1016/j.rehab.2021.101553. Online ahead of print.

Background: Adults with cerebral palsy (CP) in the United States die much earlier than those without CP, a health inequality likely shaped by causes of death. Existing research has not considered demographic differences in mortality patterns. Objectives: To analyze differences in cause of death for adults who did/did not have CP reported on their death certificates and to assess sex and racial-ethnic difference in causes of death among adult decedents with CP. Methods: Data are from the 2013-2017 US Multiple Cause-of-Death Mortality files (N=13,332,871; n=13,897 with CP). Multiple logistic regression models were used to compare differences in causes of death between adults with and without CP and to determine sex and racial-ethnic differences in causes of death among adults with CP. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were estimated. Results: As compared with decedents without CP, those with CP were more likely to die from pneumonitis (aOR 31.14, 95% CI 29.42-32.96), influenza/pneumonia (8.78, 8.30-9.29), respiratory failure (17.24, 15.19-18.69), and choking (20.66, 18.86-22.62) and less likely to die from heart disease (0.61, 0.58-0.65), cancer (0.12, 0.11-0.13), chronic lower respiratory diseases (0.50, 0.44-0.56), and cerebrovascular diseases (0.66, 0.59-0.75). Among adults with CP, female decedents were more likely than males to die from respiratory failure (1.21, 1.03-1.42), and non-Hispanic Black decedents were more likely than non-Hispanic White decedents to die from heart disease (1.24, 1.07-1.45) and cerebrovascular disease (1.77, 1.29-2.49). Conclusions: In 2013-2017, heart disease was the leading cause of death for adults with and without CP. However, for people with compared to those without CP, likelihood of death from likely preventable respiratory causes of death was higher. Non-Hispanic Black adults were more likely than non-Hispanic White adults to die from heart and cerebrovascular diseases. Public health, clinical, and rehabilitation efforts must use a multifaceted approach to address respiratory and circulatory health among people with CP. Database: United States National Vital Statistics System of the Centers for Disease Control and Prevention Multiple Cause of Death Mortality files (National Bureau of Economic Research: https://www.nber.org/research/data/vital-statistics-mortality-data-nber).

PMID: 34273570

14. The burden of neurological disorders across the states of India: the Global Burden of Disease Study 1990-2019
India State-Level Disease Burden Initiative Neurological Disorders Collaborators

Lancet Glob Health. 2021 Aug;9(8):e1129-e1144. doi: 10.1016/S2214-109X(21)00164-9. Epub 2021 Jul 14.

Background: A systematic understanding of the burden of neurological disorders at the subnational level is not readily available for India. We present a comprehensive analysis of the disease burden and trends of neurological disorders at the state

level in India. Methods: Using all accessible data from multiple sources, we estimated the prevalence or incidence and disability-adjusted life-years (DALYs) for neurological disorders from 1990 to 2019 for all states of India as part of the Global Burden of Diseases, Injuries, and Risk Factors Study 2019. We assessed the contribution of each neurological disorder to deaths and DALYs in India in 2019, their trends in prevalence or incidence and DALY rates over time, and heterogeneity between the states of India. We also assessed the Pearson correlation coefficient between Socio-demographic Index (SDI) of the states and the prevalence or incidence and DALY rates of each neurological disorder. Additionally, we estimated the contribution of known risk factors to DALYs from neurological disorders. We calculated 95% uncertainty intervals (UIs) for the mean estimates. Findings: The contribution of non-communicable neurological disorders to total DALYs in India doubled from 4·0% (95% UI 3·2-5·0) in 1990 to 8·2% (6·6-10·2) in 2019, and the contribution of injury-related neurological disorders increased from 0·2% (0·2-0·3) to 0·6% (0·5-0·7). Conversely, the contribution of communicable neurological disorders decreased from 4·1% (3·5-4·8) to 1·1% (0·9-1·5) during the same period. In 2019, the largest contributors to the total neurological disorder DALYs in India were stroke (37·9% [29·9-46·1]), headache disorders (17·5% [3·6-32·5]), epilepsy (11·3% [9·0-14·3]), cerebral palsy (5·7% [4·2-7·7]), and encephalitis (5·3% [3·7-8·9]). The crude DALY rate of several neurological disorders had considerable heterogeneity between the states in 2019, with the highest variation for tetanus (93·2 times), meningitis (8·3 times), and stroke (5·5 times). SDI of the states had a moderate significant negative correlation with communicable neurological disorder DALY rate and a moderate significant positive correlation with injury-related neurological disorder DALY rate in 2019. For most of the non-communicable neurological disorders, there was an increase in prevalence or incidence from 1990 to 2019. Substantial decreases were evident in the incidence and DALY rates of communicable neurological disorders during the same period. Migraine and multiple sclerosis were more prevalent among females than males and traumatic brain injuries were more common among males than females in 2019. Communicable diseases contributed to the majority of total neurological disorder DALYs in children younger than 5 years, and non-communicable neurological disorders were the highest contributor in all other age groups. In 2019, the leading risk factors contributing to DALYs due to non-communicable neurological disorders in India included high systolic blood pressure, air pollution, dietary risks, high fasting plasma glucose, and high body-mass index. For communicable disorders, the identified risk factors with modest contributions to DALYs were low birthweight and short gestation and air pollution. Interpretation: The increasing contribution of non-communicable and injury-related neurological disorders to the overall disease burden in India, and the substantial state-level variation in the burden of many neurological disorders highlight the need for state-specific health system responses to address the gaps in neurology services related to awareness, early identification, treatment, and rehabilitation.

PMID: 34273302

15. Temporal Trends in Neurodevelopmental Outcomes to 2 Years After Extremely Preterm Birth

Jeanie L Y Cheong , Joy E Olsen, Katherine J Lee, Alicia J Spittle, Gillian F Opie, Marissa Clark, Rosemarie A Boland, Gehan Roberts, Elisha K Josev, Noni Davis, Leah M Hickey, Peter J Anderson, Lex W Doyle, Victorian Infant Collaborative Study Group

JAMA Pediatr. 2021 Jul 19. doi: 10.1001/jamapediatrics.2021.2052. Online ahead of print.

Importance: Survival of infants born extremely preterm (EP) (<28 weeks' gestation) has increased since the early 1990s. It is necessary to know whether increased survival is accompanied by increased neurodevelopmental disability. Objective: To examine changes in major (ie, moderate or severe) neurodevelopmental disability and survival free of major neurodevelopmental disability at 2 years in infants born EP. Design, setting, and participants: Four prospective longitudinal cohort studies comprising all EP live births at 22 to 27 weeks' gestation from April 1, 2016, to March 31, 2017, and earlier eras (1991-1992, 1997, and 2005), and contemporaneous term-born controls in the state of Victoria, Australia. Among 1208 live births during the periods studied, data were available for analysis of 2-year outcomes in 1152 children: 422 (1991-1992), 215 (1997), 263 (2005), and 252 (2016-2017). Data analysis was performed from September 17, 2020, to April 15, 2021. Exposures: Extreme preterm live birth. Main outcomes and measures: Survival, blindness, deafness, cerebral palsy, developmental delay, and neurodevelopmental disability at 2 years' corrected age. Developmental delay comprised a developmental quotient less than -1 SD relative to the control group means on the Bayley Scales for each era. Major neurodevelopmental disability comprised blindness, deafness, moderate to severe cerebral palsy, or a developmental quotient less than -2 SDs. Individual neurodevelopmental outcomes in each era were contrasted relative to the 2016-2017 cohort using logistic regression adjusted for gestational age, sex, birth weight z score, and sociodemographic variables. Changes in survival free of major neurodevelopmental disability over time were also assessed using logistic regression. Results: Survival to 2 years was highest in 2016-2017 (73% [215 of 293]) compared with earlier eras (1991-1992: 53% [225 of 428]; 1997: 70% [151 of 217]; 2005: 63% [170 of 270]). Blindness and deafness were uncommon (<3%). Cerebral palsy was less common in 2016-2017 (6%) than in earlier eras (1991-1992: 11%; 1997: 12%; 2005: 10%). There were no obvious changes in the rates of developmental quotient less than -2 SDs across eras (1991-1992: 18%; 1997: 22%; 2005: 7%; 2016-2017: 15%) or in rates of major neurodevelopmental disability (1991-1992: 20%; 1997: 26%; 2005: 15%; 2016-2017: 15%). Rates of survival free of major neurodevelopmental disability increased steadily over time: 42% (1991-1992), 51% (1997), 53% (2005), and 62% (2016 -2017) (odds ratio, 1.30; 95% CI, 1.15-1.48 per decade; P < .001). Conclusions and relevance: These findings suggest that

survival free of major disability at age 2 years in children born EP has increased by an absolute 20% since the early 1990s. Increased survival has not been associated with increased neurodevelopmental disability.

PMID: 34279561

16. Emergency department usage by adults with cerebral palsy: A retrospective cohort study
Jaskirath Gill, Prue Morgan, Joanne Enticott

Emerg Med Australas. 2021 Jul 19. doi: 10.1111/1742-6723.13832. Online ahead of print.

Objective: To retrospectively profile the ED usage for a cohort of adults with cerebral palsy (CP). Methods: Five years of ED data from a Victorian hospital network was analysed to identify participants with CP using the Victorian Emergency Minimum Dataset supplemented with scrutiny of inpatient admission data to identify cases because of limited ED coding of CP. Presentation frequency, emergency diagnoses (International Classification of Diseases, 10th Revision codes) and presentation sequelae were calculated and described. An investigation into rates of low urgency presentations was conducted. Differences between adult and paediatric cohorts were described. Results: Participants with CP constituted 1586 ED presentations. Adults represented 43% (n = 689) of these. Thirty percent of adults presented more than five times over the study period, with respiratory (25%), gastrointestinal (17%) and epilepsy/convulsion diagnoses (11%) being the most common presentations. Rates of inpatient hospital admissions from the ED increased with age in adults ($P < 0.001$). Low urgency presentations made up 8.9% of total adult presentations. Conclusions: The high rates of respiratory diagnoses and epilepsy/convulsions, both ambulatory care-sensitive conditions, may be indicative of transitional challenges between paediatric and adult healthcare, potentially highlighting difficulties in accessing primary care services. Relatively low rates of 'low urgency' presentations may suggest perceived medical fragility in this vulnerable population. People with CP who present to ED and were not admitted may be underrepresented in this data. National expansion of this research will aid the development of an evidence-based model of care for CP in Australia.

PMID: 34278708

17. Cerebral palsy in children born after assisted reproductive technology: a meta-analysis
Fang-Fang Wang, Tao Yu, Xiao-Lu Chen, Rong Luo, De-Zhi Mu

Review World J Pediatr. 2021 Jul 20. doi: 10.1007/s12519-021-00442-z. Online ahead of print.

Background: Several studies have assessed the association between cerebral palsy (CP) and assisted reproductive technology (ART), but the results remain controversial. We conducted a meta-analysis to evaluate the risk of CP after ART compared with natural conceptions and to examine CP risk separately in ART singletons, multiples and preterm births. Methods: Web-based databases (PubMed, Embase, the Cochrane Library, and Web of Science) were searched until November 22, 2020. Studies which compare CP rates after ART with natural conceptions were included. The Newcastle-Ottawa Scale was used to assess the quality of the included studies. Effect estimates were extracted and combined using the fixed-effects or random-effects model depending on the heterogeneity test. Results: There were nine studies included in the meta-analysis. The included studies were of moderate or high quality. A significantly higher risk of CP [odds ratio (OR) = 2.17, 95% confidence interval (CI) 1.72-2.74] was found in ART children (n = 89,214) compared with naturally conceived children (n = 4,160,745). The significantly higher risk decreased when data were restricted to singletons (OR = 1.36, 95% CI 1.16-1.59) and disappeared when data were restricted to multiples (OR = 1.05, 95% CI 0.86-1.29) or preterm births (OR = 1.53, 95% CI 0.66-3.56). Subgroup and sensitivity analyses indicated that the overall results were robust. Conclusions: The risk of CP is increased more than two-fold after ART. This increased risk is largely due to increased rates of multiple birth and preterm delivery in ART children.

PMID: 34283367

18. Neuroimaging in Perinatal Stroke and Cerebrovascular Disease
Adam E. Goldman-Yassen, Seena Dehkharghani, Seena Dehkharghani, editors.

In: Stroke [Internet]. Brisbane (AU): Exon Publications; 2021 Jun 18. Chapter 1.

Approximately one-quarter of childhood strokes occur in the perinatal period, which includes both fetuses and neonates, affecting between one in 2300–5000 births and representing the primary cause of cerebral palsy. Although the pathogenesis is incompletely understood, risk factors for perinatal stroke are often unique from strokes at other ages, with a combination of maternal, obstetric, anatomic, and genetic factors or predispositions leading to infarct. Clinical presentations of perinatal stroke differ from strokes in older children and adults, often presenting as encephalopathy, seizure, altered mental status, or neurologic deficits. However, neuroimaging remains equally indispensable for diagnosis and prognostication. Here, we provide a comprehensive review of perinatal strokes occurring in fetal and neonatal periods, and discuss the etiologies, diagnosis, management, and prognosis, with a focus on neuroimaging utilization and findings. Understanding the appropriate use of imaging in the distinct clinical entity of perinatal stroke is important for guiding appropriate clinical management.

PMID: 34279886

19. Relevant factors of self-care in children and adolescents with spastic cerebral palsy
Yasuaki Kusumoto, Kenji Takaki, Tadamitsu Matsuda, Osamu Nitta

PLoS One. 2021 Jul 21;16(7):e0254899. doi: 10.1371/journal.pone.0254899. eCollection 2021.

Objective: Manual ability is considered one of the factors that can predict functional independence in activities of daily living. For evaluating personal tasks such as self-care, the Pediatric Evaluation of Disability Inventory (PEDI) comprises/introduces/ offers a set of useful measures that assist in enhancing the capability for self-care among children and adolescents with cerebral palsy (CP). The aim of this study was to investigate the relevant factors of self-care capability and performance in children and adolescents with spastic CP. Methods: This was a cross-sectional study. Seventy-six children and adolescents with spastic CP (between 5 and 18 years of age), representing levels I to IV of the Gross Motor Function Classification System-Expanded & Revised version (GMFCS), were analyzed. Multiple linear regression analysis with forward stepwise selection was conducted to examine which determinants were related to self-care capability and performance. Independent variables were age, CP type, GMFCS, Manual Ability Classification System, Box and Block Test, and grip strength in the dominant and non-dominant hands. Dependent variables were scores for the PEDI Functional Skills Scale and the PEDI Caregiver Assistance Scale. Results: Results of the multiple regression analysis showed that the PEDI Functional Skills scale scores were correlated with the Box and Block Test in the dominant hand and GMFCS (Adjusted R2 = 0.69). The PEDI Caregiver Assistance Scale scores were correlated with the Box and Block Test in the dominant hand, GMFCS, and age (adjusted R2 = 0.71). Conclusion: When considering self-care of children and adolescents with spastic CP, it is necessary to consider the evaluation of upper limb dysfunction in addition to GMFCS.

PMID: 34288946

20. Effect of Physical Guidance on Learning a Tracking Task in Children with Cerebral Palsy
Hadi Nobari, Elham Azimzadeh, Hamidollah Hassanlouei, Georgian Badicu, Jorge Pérez-Gómez, Luca Paolo Ardigò

Int J Environ Res Public Health. 2021 Jul 3;18(13):7136. doi: 10.3390/ijerph18137136.

The purpose of this study was to investigate the effect of physical guidance (PG) frequency on learning a tracking task in children with hemiplegic spastic cerebral palsy (CP). For this purpose, 25 children, aged 7-15 years with CP affecting the left side of the body, who were classified in levels II-III of Manual Abilities Classification System (MACS) and levels III-IV of Gross Motor Function Classification System (GMFCS), were recruited from 10 clinical centers. A pre-test including two blocks of 12 trials of the tracking task without any PG was performed by all participants, after that they were assigned into five homogenous groups (with 100%, 75%, 50%, 25%, and 0% of PG) through blocked randomization according to their age. All participants involved in an intervention consisted of eight sessions (four blocks of 12 trials in each session) practicing a tracking task. The 0% PG group received no PG, the 25% PG group received PG for three trials, the 50% PG group received PG for six trials, the 75% PG group received PG for nine trials, and the 100% PG group received PG for all twelve trials. PG consisted of placing the experimenter's hand around the child's less-involved hand guiding to stay on the track and complete the task. Learning was inferred by acquisition and delayed retention tests. The results showed that the higher frequency of PG led to more accurate performance during practice phase. However, the group that received 75% PG had significantly better performance compared to the other groups in the retention phase. It is concluded that optimum level of PG, about 75% of trials,

can be helpful for learning a tracking task in children with spastic hemiplegic CP, supporting the challenge point framework.

PMID: 34281074

21. The Relationship Between Functional Motor Status and Self-evaluation in Individuals With Cerebral Palsy: A Systematic Review
Meysam Roostaei, Nazila Akbarfahimi, Hamid Dalvand, Shiva Abedi

Review Iran J Child Neurol. Summer 2021;15(3):9-27. doi: 10.22037/ijcn.v15i4.26438.

Cerebral palsy (CP) is a common pediatric disorder that results in a wide range of motor and functional problems that impose mobility limitations, decrease the quality of movement, negatively affect physical activity participation, self-care, and academic performance, and ultimately result in social isolation and negative self-evaluation. Despite abundant evidence of motor function, very few studies investigated all aspects of self-evaluation or described the relationship between motor function and self in individuals with CP. The present study aimed at investigating the relationship between functional motor status and self-evaluation in individuals with CP. A systematic search was performed in six electronic databases (PubMed, Scopus, ProQuest, OTseeker, Web of Sciences, and Google Scholar) for English language articles from any date to May 2019. Screening, selection, and quality assessment were conducted by two authors independently. All studies recruiting individuals with CP and using functional motor status and self-evaluation tests were included. The AXIS checklist was used for the quality assessment of included studies. As all data sources were generated by published studies, ethical approval was not applicable to the present study. Seven articles met the inclusion criteria. These studies investigated the relationship between functional motor status and self-esteem and self-concept. Based on the AXIS, three articles were identified as high quality and four as low quality. The result of the present review showed that there was no relationship between self-concept and functional motor status in individuals with CP, while there was a significant relationship between self-esteem and functional motor status. More studies are required to shed light on other aspects of self and relationship of self-evaluation with motor function in individuals with CP.

PMID: 34282359

22. Comparison of Quality of Life Following Single-Event Multilevel Surgery (SEMLS) Using Bandaging and Casting Immobilization Methods in Cerebral Palsy Children
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Iran J Child Neurol. Summer 2021;15(3):55-64. doi: 10.22037/ijcn.v15i2.17361.

Objective: Cerebral palsy (CP) is a non-progressive Neurodevelopmental disorder mainly treated using Single-event multilevel surgery (SEMLS). SEMLS contains using a casting method to immobilize the operated limb. However, in the present study, in addition to casting, the bandaging method was also applied. Bandaging is a newer method compared to casting. No study has used bandage for post-surgery immobilization. According to the best knowledge of the authors, no study has compared the outcome of bandage and cast for postoperative immobilization regarding the rehabilitation and quality of life (QoL) in the first and third months following the surgery, within the recovery period, which is associated with consequences like caring, hygiene, transferring, and mobility that affect the spirit and function of children. As a result, we decided to investigate the effect of these methods on the QoL of children the following surgery to treat CP. Materials & methods: Following an analytical cross-sectional design, 100 children (aged 4-12 years) were randomly divided into hemiplegic and diplegic CP. The Cerebral Palsy QoL questionnaire (CP QOL-Child) was filled by parents of the participants. Based on the type of administered immobilizer, 80 children were randomly divided into two groups (40 subjects in each group). All subjects were evaluated using a similar questionnaire in the first and third months after surgery. The non-parametric Mann-Whitney test and ANOVA test were used to compare the study groups. Results: The mean ratio of QoL changes, based on the CP QoL-Child questionnaire, was significantly increased in the bandage group during the first month after surgery. However, for the cast group, this parameter was significantly decreased ($P<0.001$). In the third month after surgery, the mean ratio of QoL changes was significantly increased in both groups, but the difference in the mean ratio of QoL changes between the two methods wasn't significant ($P=0.64$). Conclusion: In the first month after surgery, the bandaging method was more effective than the casting method, but in the third month, the outcomes were similar for both groups.

PMID: 34282363

23. Construct Validity and Reliability of the Children Participation Assessment Scale-Child version in Children with Physical Disabilities
Omid Rostamzadeh, Malek Amini, Afsoon Hassani Mehrban

Iran J Child Neurol. Summer 2021;15(3):99-108. doi: 10.22037/ijcn.v15i3.26089.

Objective: This study was conducted to determine the construct validity and reliability of the Children Participation Assessment Scale in activities outside of School-Child version (CPAS-C) in 6-12-year-old children with physical disabilities (PDs). Materials & methods: In this methodological study, participants were 100 children with PDs, recruited from a school for exceptional children with physical-motor disabilities and 100 normally developing children. For assessing the test-retest reliability (ICC), 40 children with PDs completed CPAS-C within a two-week interval, and for assessing the internal consistency (Cronbach's alpha) and construct validity, 100 children with PDs separately completed the Vinland Adaptive Behavioral Scale (VABS) and CPAS-C. Result: The majority of participants were children with CP, among whom the highest and lowest ratios were related to diplegia (32%) and dystonia (1%), respectively. The results showed that CPAS-C had acceptable reliability (ICC: 0.6-0.99). Cronbach's α score was between weak to moderate (α = 0.25-0.75). The difference in the score of participation between the two groups (normally developing children and children with physical disabilities) was significant in all areas (P<0.001). Conclusion: The CPAS-C had acceptable psychometric properties; it can be used as a valid and reliable tool for assessing the participation of 6-12-year-old children with PDs in school activities.

PMID: 34282367

24. Anesthetic Considerations In Patients With Cerebral Palsy
Brady Miller, Bryan Rondeau

In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. 2021 Jun 15.

Cerebral palsy is a group of permanent neurodevelopmental disorders that affects an individual’s muscle tone, motor functions, movement, and posture. It encompasses a broad spectrum of clinical symptoms affecting multiple organ systems, with clinical presentation varying widely between individuals. It occurs in approximately 2 per 1,000 live births, and incidence has remained stable, or slightly increased, over the last 50 years. Patients with cerebral palsy are often encountered in the perioperative setting for a variety of indications, including orthopedic or neurosurgical procedures, gastrostomy tubes or tracheostomy, dental extractions, and imaging, to name a few. Cerebral palsy poses a particular challenge to the anesthesiologist. Appropriate perioperative management requires a meticulous understanding of the etiology, pathophysiology, and clinical implications of this group of disorders.

PMID: 34283423

25. Toning up but powering down: does mitochondrial dysfunction lead to loss of ambulation in cerebral palsy?
Robert McFarland

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