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Professor Nadia Badawi AM
Macquarie Group Foundation Chair of Cerebral Palsy

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Interventions and Management

1. Community-Based Upper Extremity Power Training for Youth with Cerebral Palsy: A Pilot Study.
Colquitt G, Kiely K, Caciula M, Li L, Vogel RL, Moreau NG.

Aim: To examine the effects of an upper-extremity, community-based, and power-training intervention. Methods: Twelve participants with cerebral palsy (CP) [8 males, 4 females; mean age 14 years 6 months (SD 5 years 4 months), range 7-24] were randomly assigned to a rest-training (RT; n = 6) or training-rest (n = 6) group in this randomized, cross-over design. Training took place in participants' home or school, three times per week for 6 weeks. We examined changes in upper extremity average power output (Pavg) in watts (W) and changes in function via the Pediatric Outcomes Data Collection Instrument (PODCI). Results: Each participant completed at least 15 of the 18 total training sessions (91.2% adherence). Pavg increased 92.2% on average among participants (p < .05). There was a significant three-way interaction among treatment, sequence, and period with the data stratified by (Bimanual Fine Motor Function [BFMF]) level on the pain subscale of the PODCI (p = 0.0118). All participants decreased pain after training with the exception of individuals with lower functioning (BFMF II-V) in the RT group. Conclusion: A community-based upper extremity power-training intervention was feasible and effective at improving power among young people with CP and has the potential to improve pain.

PMID: 31282292

2. Botulinum toxin type A injection increases range of motion in hip, knee and ankle joint contractures of children with cerebral palsy.
Aktaş E, Ömeroğlu H.

OBJECTIVES: This study aims to evaluate the clinical outcomes of children with spastic type cerebral palsy (CP) treated with botulinum toxin type A (BoNT-A) injection for lower limb contracture and the influence of age, gender, functional level and degree of initial contracture on treatment outcomes. PATIENTS AND METHODS: Clinical records at pre-BoNT-A injection and post-BoNT-A injections of 153 sessions of a total of 118 consecutive children (67 boys, 51 girls; mean age 5.9±2.6 years; range, 2.5-16 years) were retrospectively evaluated. Degrees of pre- and post-injection contracture were evaluated. Post-injection supplemental casting for 10 days was recorded in all cases. Less than 20° of hip flexion contracture, more than 30° of hip abduction, a negative prone Ely test, less than 50° of popliteal angle and at least 5° of ankle dorsiflexion values at post-injection were accepted as sufficient clinical improvement. RESULTS: Sufficient post-injection range of motion (ROM) was observed in 80% of cases with hip flexion contracture, in 45% of cases with hip adduction contracture, in 84% of cases with knee flexion contracture and in 77% of cases with ankle equinus contracture. Prone Ely test that was positive in 60% of cases with knee extension contracture was negative at post-injection. Improvement in contractures were prominent in children with

lesser degree initial contractures. CONCLUSION: Botulinum toxin type A injection increases ROM in hip, knee and ankle joint contractures in CP. Although age, gender and functional level may influence the clinical outcomes, pre-treatment level of contracture is the main determinant in improvement in ROM at post-injection.

PMID: 31291865

3. [Botulinum toxin treatment in children with cerebral palsy].
Terebessy T, Domos G, Hevér D, Horváth N, Kiss S, Szőke G.

Orv Hetil. 2019 Jul;160(28):1105-1111. doi: 10.1556/650.2019.31415. [Article in Hungarian; Abstract available in Hungarian from the publisher]

Introduction: Botulinum toxin is used for decreasing spasticity, improving gait pattern and preventing secondary deformities and orthopedic surgeries in children with cerebral palsy. Despite its wide use, there is no evidence for the long-term beneficial effect of the toxin. Aim: The authors focused on the short-term effects of the toxin and on the subjective evaluation done by the parents about the botox treatment. Method: First, the calf muscle of 18 children was treated and casting was also performed. In our second patient group, multilevel lower limb injection was done in 12 cases. Joints' range of motion, muscle tone and spasticity were assessed before and 4-6 weeks after treatment. In ambulatory children, gait analysis was done. Side effects were recorded and parental opinion about the treatment was requested. Results: Increased ankle range of motion and decreased muscle tone and spasticity were seen in our first patient group. In the second group, hip flexion contracture became milder and hip abduction and the popliteal angle improved. However, gait analysis results only slightly changed after botox treatment. Occasional mild and transient adverse effects were observed during the pharmacologically active period of the toxin. Associate beneficial effects were also reported such as better comfort, easier movements, improving function of the non-injected upper limb, decreasing dysarthria and dysphagia. Conclusion: Our study strengthens the observation that botox treatment of the spastic calf muscle together with plaster casting can result in improved ankle dorsiflexion. Multilevel botox treatment can improve lower limb joints range of motion, however, gait pattern remains unchanged. The administration of botulinum toxin with respect to the guidelines has no major adverse effects. Further studies are needed to clarify the observed beneficial associate effects of the toxin. Orv Hetil. 2019; 160(28): 1105-1111.

PMID: 31280598

4. Movement Analysis in Orthopedics and Trauma Surgery - Measurement Systems and Clinical Applications.
Oppelt K, Hogan A, Stief F, Grützner PA, Trinler U.

Z Orthop Unfall. 2019 Jul 10. doi: 10.1055/a-0873-1557. [Epub ahead of print] [Article in English, German; Abstract available in German from the publisher]

BACKGROUND: Technical development lead to an enhancement of clinical movement analysis in the last few decades and expanded its research and clinical applications. Since the mid 20th century, human movement analysis has made its way into clinical practice, e.g. in treating poliomyelitis and infantile cerebral palsy. Today, it has a wide range of applications in various clinical areas. The aim of this narrative review is to illustrate the variety of camera-based systems for human movement analysis and their clinical applications, specifically in the field of orthopaedics and trauma surgery (O/U). Benefits and limitations of each system are shown. Future development and necessary improvements are discussed. MATERIAL AND METHODS: A selective literature review was undertaken with the databases PubMed and Google Scholar using keywords related to clinical human movement analysis in the field of orthopaedics and trauma surgery. Furthermore standard book references were included. RESULTS: Common video camera systems (VS) are used for basic visual movement analysis. Instrumented movement analysis systems include marker-based systems (MBS), markerless optical systems (MLS) and rasterstereographic analysis systems (VRS). VS, MBS and MLS have clinical use for dynamic examination of patients with various disorders in movement and gait. Among such are e.g. neuro-orthopaedic disorders, muscular insufficiencies, degenerative and post-trauma deficiencies with e.g. resultant pathologic leg axis. Besides the measurement of kinematic data by MBS and MLS, the combination with kinetic measurements to detect abnormal loading patterns as well as the combination with electromyography (EMG) to detect abnormal muscle function is a great advantage. Validity and reliability of kinematic measurements depend on the camera systems (MBS, MLS), the applied marker models, the joints of interest and the observed movement plane. Movements in the sagittal plane of the hip and knee joint, pelvic rotation and tilt as well as hip abduction are generally measured with high reliability. In the frontal and transverse planes of the knee and ankle joint substantial angular variabilities were noted due to the small range of motion of the joints in these planes. Soft tissue artefacts and marker placement are the biggest sources of errors. So far MLS did not improve these limitations. MBS are most accurate and remain the gold-standard in clinical and scientific movement analysis. VRS is used clinically for static 3D-analysis of the trunk posture and spine deformities. Current systems allow the dynamic measurement and visualisation of trunk and spine movement in 3D

during gait and running. Planar x-ray-imaging (Cobb's angle) and to some extent cross sectional imaging with CT-scan or MRI are commonly used for the evaluation of patients with spinal deformities. VRS offers functional 3D data of trunk and spine deformities without radiation exposure, thus allowing safer clinical monitoring of the mainly infantile and adolescent patients. The accuracy, validity and reliability of measurements of different VRS-systems for the clinical use has been proven by several studies. CONCLUSION: The instrumented movement analysis is an additional tool that aids clinical practitioners of O/U in the dynamic assessment of pathologic movement and loading patterns. In conjunction with common radiologic imaging it aids in the planning of type and extent of corrective surgical interventions. In the field of orthopaedics and trauma surgery movement analysis can help as an additional diagnostic tool to develop therapeutic strategies and evaluate clinical outcomes.

PMID: 31291674

5. Factors influencing post-surgical variability in StepWatch data in youth with cerebral palsy.
Niiler TA, Nicholson K, Fischer L, Lennon N.

Gait Posture. 2019 Jun 26;72:234-238. doi: 10.1016/j.gaitpost.2019.06.017. [Epub ahead of print]

BACKGROUND: Over the past several years, activity monitors have become very popular in the general population, and due to their low cost and ease of use, are starting to be seen as clinical tools for the assessment of interventions. This presents researchers with the opportunity to better understand how activity, or lack thereof, is related to the recovery of patients. However, even in individuals without disabilities, there is a high degree of variability in activity monitor data which must be better understood in order to produce clinically meaningful interpretation of such data. RESEARCH QUESTION: What sources of variability contribute the most to the daily scatter in activity data as measured by StepWatches in youth with Cerebral Palsy (CP)? In particular, do non-clinical factors such as weather and location contribute to this variability significantly? METHODS: This was a retrospective study making use of data from our activity monitoring protocol of youths with CP who obtain single event multi-level surgeries. Before and after these surgeries, 57 such youths aged 4.2-21.3 years were issued StepWatches to monitor daily activity for 8 day periods over 24 months duration. Weather data and walk scores for the patients' home locations were collected from online databases. Steps per hour were predicted from clinical and environmental data using bootstrapped regression to determine the stability of regression coefficients and the percent variability explained by each variable. RESULTS: Time since surgery, age, season, GMFCS level, and surgical burden were significant variables in the model. Of them, GMFCS level was most important and explained nearly 16% of the variability in the data. Temperature, precipitation, and walk score had small effects on step count variance. SIGNIFICANCE: Understanding sources of variability in step-counts is important if such a measure is to be used as a clinical measure of recovery, and may be important in the consideration of future surgical planning.

PMID: 31284160

6. Pelvic Tilt Changes After Hamstring Lengthening in Children With Cerebral Palsy.
Selber PRP, Graham HK.

J Pediatr Orthop. 2019 Jul 8. doi: 10.1097/BPO.0000000000001422. [Epub ahead of print]

PMID: 31290844

7. A Six Week Therapeutic Ballet Intervention Improved Gait and Inhibitory Control in Children With Cerebral Palsy-A Pilot Study.
Lakes KD, Sharp K, Grant-Beuttler M, Neville R, Haddad F, Sunico R, Ho D, Schneider M, Sawitz S, Paulsen J, Caputo K, Lu KD, Aminian A, López-Ortiz C, Radom-Aizik S.

Front Public Health. 2019 Jun 25;7:137. doi: 10.3389/fpubh.2019.00137. eCollection 2019.

Children with cerebral palsy (CP) have motor impairments that make it challenging for them to participate in standard physical activity (PA) interventions. There is a need to evaluate adapted PA interventions for this population. Dance can promote coordination, posture, muscle strength, motor learning, and executive functioning. This pilot study evaluated the feasibility and the effects of a new therapeutic ballet intervention specifically designed for children with CP. Methods: Eight children with CP (9-14 y/o; 75% female) participated in a 6-week therapeutic ballet intervention. Outcomes were measured in multiple domains, including body composition (DXA), muscle strength (hand-grip dynamometer), habitual physical activity, gait and selective

motor control functions, and executive functioning. Follow-up assessments of habitual physical activity, gait, and executive functioning were completed 4 to 5 weeks post-intervention. Results: Five of the eight participants were overfat or obese based on DXA percentage of body fat. All participants were below the 50th percentile for their age and gender for bone density. Four participants showed a trend to improve hand-grip strength in one hand only, while one improved in both hands. There were significant improvements in gait across time points (pre, post, and follow-up), specifically in time of ambulation (X pre = 4.36, X post = 4.22, X follow-up = 3.72, d = 0.056, p = 0.02), and in step length (cm) on the right: X pre = 48.29, X post = 50.77, X follow-up = 52.11, d = 0.22, p = 0.027, and left stride: X pre = 96.29, X post = 102.20, X follow-up = 104.20, d = 0.30, p = 0.027, indicating gait changes in bilateral lower extremities. There was improvement in inhibitory control (d = 0.78; 95% Confidence Limit = ±0.71, p < 0.05) with large individual responses primarily among those above the mean at baseline. Conclusions: Therapeutic ballet may prove to be a useful intervention to promote physiological and cognitive functions in children with CP. Results demonstrated feasibility of the physical, physiological, and cognitive assessments and suggested improvements in participants' gait and inhibitory control with large individual responses. Modifications to personalize the intervention may be needed to optimize positive outcomes. Clinical Trial Registration: www.ClinicalTrials.gov, identifier: NCT03681171.

PMID: 31294009

8. Physical activity patterns in children with cerebral palsy and typically developing peers.
Okur EO, Inal-Ince D, Saglam M, Vardar-Yagli N, Arikan H.

Physiother Theory Pract. 2019 Jul 12:1-9. doi: 10.1080/09593985.2019.1641863. [Epub ahead of print]

Objective: To compare physical activity level between children with cerebral palsy and typically developing peers using accelerometer and activity diary. Method: Twenty children with spastic cerebral palsy Level I and II according to Gross Motor Function Classification System, and 20 healthy age- and sex-matched typically developing peers were included. An activity diary was logged, and each child wore an accelerometer for 4 days, 2 weekdays and 2 weekend days. Results: Total and physical activity energy expenditure assessed using either accelerometer or activity diary was markedly lower in children with spastic cerebral palsy compared to typically developing peers. Moderate and vigorous physical activities and daily total energy expenditure assessed using activity diary were significantly lower in children with cerebral palsy than those of typically developing peers (p < .05). There was a significant relationship between accelerometer and activity diary in total energy expenditure for children with cerebral palsy (r = 0.752, p < .001) and typically developing peers (r = 0.732, p < .001) and a moderate significant relationship in physical activity energy expenditure for children with cerebral palsy (r = 0.463, p = .040). Conclusion: In this study, children with cerebral palsy had lower physical activity levels than their typically developing peers. The activity diary provided detailed information about physical activities and was correlated with accelerometer data. The activity diary could be a valid measure of physical activity levels in children with cerebral palsy.

PMID: 31298601

9. Effects of Therapeutic Exercise Intensity on Cerebral Palsy Outcomes: A Systematic Review With Meta-Regression of Randomized Clinical Trials.
Hsu CW, Kang YN, Tseng SH.

Front Neurol. 2019 Jun 21;10:657. doi: 10.3389/fneur.2019.00657. eCollection 2019.

Background and Objective: Intensive physical therapy or exercise has been associated with favorable cerebral palsy (CP) outcomes, but few studies have investigated the effects of exercise intensity on the improvement in CP outcomes. In this study, we assessed the effects of intensive exercise-based therapy on improvement in gross motor function in children with CP. Methods: We searched three databases for randomized clinical trials evaluating the effects of therapeutic exercise training by using Gross Motor Function Measurement (GMFM) 66 and 88 among children with CP. Studies that used interventions in addition to therapeutic exercise were excluded from the present meta-analysis. Exercise intensity was defined using the number of training hours per day and duration of intervention (in weeks). The effects of the number of daily training hours and program duration on GMFM improvement were evaluated using meta-regression. Results: The comprehensive search returned 270 references, and 13 of 270 references met our eligibility criteria. The 13 trials recruited 412 children with CP. These trials measured motor improvements by using GMFM-66 (n = 8) and GMFM-88 (n = 5). The GMFM scores in the children who received the therapeutic intervention did not show significantly greater improvement than those of the children who received standard care. Meta-regression analysis revealed that the improvement in GMFM scores was positively associated with the number of daily training hours (point estimate = 0.549; p = 0.031) and program duration (point estimate = 0.067; p = 0.075). Discussion and Conclusions: Intensive physical exercise improved CP outcomes in the intervention and standard therapy groups. The duration of therapeutic intervention improved CP outcomes among the children who received the therapeutic

intervention, while an increase in the number of daily training hours improved in CP outcomes in the children who received standard therapy.

PMID: 31293501

10. Mu rhythm: state of the art with special focus on cerebral palsy.
Démas J, Bourguignon M, Périvier M, Tiège X, Dinomais M, Bogaert PV.

Ann Phys Rehabil Med. 2019 Jul 9. pii: S1877-0657(19)30094-6. doi: 10.1016/j.rehab.2019.06.007. [Epub ahead of print]

Various specific early rehabilitation strategies are proposed to decrease functional disabilities in patients with cerebral palsy (CP). These strategies are thought to favour the mechanisms of brain plasticity that take place after brain injury. However, the level of evidence is low. Markers of brain plasticity would favour validation of these rehabilitation programs. In this paper, we consider the study of mu rhythm for this goal by describing the characteristics of mu rhythm in adults and children with typical development, then review the current literature on mu rhythm in CP. Mu rhythm is composed of brain oscillations recorded by electroencephalography (EEG) or magnetoencephalography (MEG) over the sensorimotor areas. The oscillations are characterized by their frequency, topography and modulation. Frequency ranges within the alpha band (˜10 Hz, mu alpha) or beta band (˜20 Hz, mu beta). Source location analyses suggest that mu alpha reflects somatosensory functions, whereas mu beta reflects motor functions. Event-related desynchronisation (ERD) followed by event-related (re-)synchronisation (ERS) of mu rhythm occur in association with a movement or somatosensory input. Even if the functional role of the different mu rhythm components remains incompletely understood, their maturational trajectory is well described. Increasing age from infancy to adolescence is associated with increasing ERD as well as increasing ERS. A few studies characterised mu rhythm in adolescents with spastic CP and showed atypical patterns of modulation in most of them. The most frequent findings in patients with unilateral CP are decreased ERD and decreased ERS over the central electrodes, but atypical topography may also be found. The patterns of modulations are more variable in bilateral CP. Data in infants and young children with CP are lacking and studies did not address the questions of intra-individual reliability of mu rhythm modulations in patients with CP nor their modification after motor learning. Better characterization of mu rhythm in CP, especially in infants and young children, is warranted before considering this rhythm as a potential neurophysiological marker of brain plasticity.

PMID: 31299375

11. Investigation of the relationship between quality of life, activity-participation and environmental factors in adolescents with cerebral palsy.
Burak M, Kavlak E.

NeuroRehabilitation. 2019 Jul 2. doi: 10.3233/NRE-192688. [Epub ahead of print]

BACKGROUND AND OBJECTIVE: The aim of this study is to examine the relationship between quality of life, activity-participation and environmental factors in adolescents with cerebral palsy. METHODS: Seventy-five adolescents (M:45, F:30) ages between 14-18yrs (mean: 15.52±1.60yrs) were included in the study. Participants were divided into three groups: Level I, Level II and Level III according to the Gross Motor Function Classification System. Gross Motor Function Classification System, Gross Motor Function Measure, Functional Independence Scale, Manuel Ability Classification System, Pediatric Quality of Life Inventory and International Classification of Functioning, Disability and Health Child-Youth version Short Form (ICF-CY) (14-18yrs) were used for assessments. RESULTS: It is found that there is a moderate and high level of correlation between quality of life and activity participation and body functions; moderate and high level of correlation between quality of life and activity participation and body functions with the gross motor function levels; moderate and low level correlation between environmental factors and gross motor function levels (p<0,05). CONCLUSIONS: The fact that the ICF-CY short form used for cerebral palsied children is compatible with other assessment scales suggests that the use of ICF-CY short forms may be useful in assessing the health status of individuals.

PMID: 31282433

12. Beyond stereotypes of cerebral palsy: exploring the lived experiences of young Canadians.
Hanes JE, Hlyva O, Rosenbaum P, Freeman M, Nguyen T, Palisano RJ, Gorter JW.

Child Care Health Dev. 2019 Jul 11. doi: 10.1111/cch.12705. [Epub ahead of print]

BACKGROUND: Health for people with cerebral palsy (CP) must extend beyond physical impairments to include social, environmental and psychological factors that are rarely captured by quantitative research alone. This qualitative study sought to explore the lived experience of young people with CP with their physical, mental and emotional health in the context of a larger longitudinal Canadian study focusing on brain function, physical and mental health, and well-being. METHODS: An integrated research team (including people with CP or other impairments, clinicians and researchers) was formed to study participant-identified research needs. A purposive sample of 16 people with CP (7 female), aged 17-29, GMFCS levels I-V participated in three focus groups that were conceptualized and analyzed using interpretive description methodology. RESULTS: This study reports the experiences of people with CP across GMFCS levels and identifies some consequences of growing up with the condition: physical and mental health issues, importance of meaningful participation, impact of the environment and identity formation. Participants shared challenges related to accessibility, healthcare, social/environmental supports, relationships, and sustainable employment. DISCUSSION: Body structure and function challenges impact participation in activities of daily living, threatening participants' ability to form positive identities and live meaningful lives. People with CP desire to work, but may require additional training, accommodation and support to do so. Environmental conditions, including relationships, supportive people and accessibility shape participants' health, wellbeing, and social/civic engagement. This study confirms the need for improved care for adults with CP, including multidisciplinary adult health team(s) and community services.

PMID: 31297831

13. Longitudinal Changes in Physical Caregiving for Parents of Children with Cerebral Palsy.

Alghamdi MS, Chiarello LA, Palisano RJ, McCoy SW, Orlin M, Abd-Elkafy EM.

Aims: To determine changes in physical caregiving for parents of children with cerebral palsy (CP) over a two-year period based on children's gross motor function level and age. Methods: 153 parents of children with CP rated their physical caregiving using the Ease of Caregiving for Children three times over two years. Parents and assessors classified children's gross motor function using the Gross Motor Function Classification System (GMFCS). Physical caregiving was compared at three test times among parents of children grouped by GMFCS level (I, II-III, and IV-V) and age (1.7-5.9 and 6-11 years) using a three-way mixed ANOVA. Results: Among all analyses, a two-way interaction was found between children's GMFCS level and test time on ease of caregiving, $p < 0.01$. Change over two-year period was found for parents of children in level I and II-III, $p < 0.01$, but not parents of children in levels IV-V. At each test time, parents of children in level I reported the greatest ease of caregiving followed by parents of children in levels II-III, and levels IV-V, who reported the lowest ease of caregiving, $p < 0.001$. Conclusions: Findings support evaluation and monitoring of physical caregiving for parents of children with CP over time.

PMID: 31288611

14. Volume of Neonatal Care and Survival without Disability at 2 Years in Very Preterm Infants: Results of a French National Cohort Study.

Desplanches T, Blondel B, Morgan AS, Burguet A, Kaminski M, Lecomte B, Marchand-Martin L, Rozé JC, Sagot P, Truffert P, Zeitlin J, Ancel PY, Fresson J.

OBJECTIVES: To investigate the relation between neonatal intensive care unit (NICU) volume and survival, and neuromotor and sensory disabilities at 2 years in very preterm infants. STUDY DESIGN: The EPIPAGE-2 (Etude Epidémiologique sur les Petits Âges Gestationnels-2) national prospective population-based cohort study was used to include 2447 babies born alive in 66 level III hospitals between 24 and 30 completed weeks of gestation in 2011. The outcome was survival without disabilities (levels 2-5 of the Gross Motor Function Classification System for cerebral palsy with or without unilateral or bilateral blindness or deafness). Units were grouped in quartiles according to volume, defined as the annual admissions of very preterm babies. Multivariate logistic regression analyses with population average models were used. RESULTS: Survival at discharge was lower in hospitals with lower volumes of neonatal activity (aOR 0.55, 95% CI 0.33-0.91). Survival without neuromotor and sensory disabilities at 2 years increased with hospital volume, from 75% to 80.7% in the highest volume units. After adjustment for gestational age, small for gestational age, sex, maternal age, infertility treatment, multiple pregnancy, principal cause of prematurity, parental socioeconomic status, and mother's country of birth, survival without neuromotor or sensory disabilities was significantly lower in hospitals with a lower volume of neonatal activity (aOR 0.60, 95% CI 0.38-0.95) than in the highest quartile hospitals. CONCLUSIONS: These results suggest that lower neonatal intensive care unit volume is associated with lower survival without an increase in disabilities at 2 years. These results could be useful to generate improvements of perinatal regionalization.

PMID: 31280891

15. Cerebellar Hemorrhage in Preterm Infants: A Meta-Analysis on Risk Factors and Neurodevelopmental Outcome.
Villamor-Martinez E, Fumagalli M, Alomar YI, Passera S, Cavallaro G, Mosca F, Villamor E.

Front Physiol. 2019 Jun 25;10:800. doi: 10.3389/fphys.2019.00800. eCollection 2019.

Cerebellar hemorrhage (CBH) represents the most commonly acquired lesion of the posterior fossa in the neonatal period. We aimed to perform a systematic review and meta-analysis of studies exploring the perinatal risk factors and neurological outcome of CBH in preterm infants. A comprehensive literature search was conducted using PubMed/MEDLINE and EMBASE. Studies were included if they examined preterm infants and reported primary data on maternal, obstetric, or perinatal characteristics, and/or outcomes of infants with and without CBH. A random-effects model was used to calculate mean differences (MD), odds ratios (OR), and 95% confidence intervals (CI). We found 231 potentially relevant studies, of which 15 met the inclusion criteria (4,236 infants, 347 CBH cases). Meta-analysis could not demonstrate a significant association between CBH and multiple gestation, chorioamnionitis, pre-eclampsia, placental abruption, use of antenatal corticosteroids, mode of delivery, or infant sex. Infants with CBH had a significantly lower gestational age (6 studies, MD -1.55 weeks, 95% CI -1.93 to -1.16) and birth weight (6 studies, MD -173 g, 95% CI -225 to -120), and significantly higher rates of intubation at birth, hypotension, patent ductus arteriosus, intraventricular hemorrhage, sepsis, necrotizing enterocolitis, and bronchopulmonary dysplasia. CBH was significantly associated with delayed mental (6 studies, OR 2.95, 95% CI 1.21 to 7.20) and psychomotor (6 studies, OR 3.62, 95% CI 1.34 to 9.76) development, and higher rates of cerebral palsy (4 studies, OR 3.09, 95% CI 1.55 to 6.19). In conclusion, the present meta-analysis shows that the youngest and sickest preterm infants are at higher risk of developing CBH. Our results highlight the multifactorial nature of CBH and reinforce the idea that cerebellar injury in very preterm newborns has important neurodevelopmental consequences among survivors.

PMID: 31293454

16. Medical Diagnosis of Cerebral Palsy Rehabilitation Using Eye Images in Machine Learning Techniques.
Illavarason P, Arokia Renjit J, Mohan Kumar P.

J Med Syst. 2019 Jul 9;43(8):278. doi: 10.1007/s10916-019-1410-6.

Cerebral Palsy (CP) is a non progressive neurological disorders commonly associated with a spectrum of developmental disabilities such as strabismus (misalignment of eye). The Eye image are captured through camera, this make the quick diagnosis and examination the periodical assessment for CP kids. By capturing the Eye Movement of 40 children with CP (aged 3-11 years) with relatively mild motor-impairment and also we have analyzed the performance of CP children periodically. Nowadays, Bio-Medical image processing and Machine learning Classification algorithm used for detection and diagnosis the certain diseases and plays the important tool to decrease the risk of any diseases. This work presents a computational methodology to automatically diagnose the Improvement of CP children and performance can be evaluated. The alternate medical evaluation techniques have shown their potential for the treatment and diagnosis of disease like strabismus and nystagmus for CP kids. The proposed method is used to measure and quantify the performance improvement by classify the abnormal eye condition of CP kids and these results attained by machine learning method. The results show the best classification accuracy of 94.17% calculated from Neural Network Classifier. Specificity Rate were absorbed as 0.9800 and Sensitivity Rate were absorbed as 0.9165 respectively. The proposed method for non-invasive and automatic detection of abnormalities in CP kids and evaluates the performance improvement more accurately.

PMID: 31289923

17. The effect of visual support strategies on the quality of life of children with cerebral palsy and cerebral visual impairment/perceptual visual dysfunction in Nigeria: study protocol for a randomized controlled trial.
Duke R, Eyong K, Burton K, MacLeod D, Dutton GN, Gilbert C, Bowman R.

Trials. 2019 Jul 10;20(1):417. doi: 10.1186/s13063-019-3527-9.

BACKGROUND: Cerebral visual impairment (CVI), including perceptual visual dysfunction (PVD), is common in children with cerebral palsy (CP). Inventories of questions relating to practical aspects of visual perception in everyday life, in particular the closed-ended Insight Questions Inventory (IQI), can be used to assess CVI/PVD. Studies linking responses to the inventory with specific visual support strategies, aimed at modifying the child's environment and/or behaviour to minimize the impact of the CVI/PVD, have been piloted. The IQI and tailored strategies have not been used in an African population, nor have they been tested in a controlled trial. This trial will compare the effectiveness of the IQI and linked visual support strategies versus

general supportive treatments on the quality of life of children with CVI/PVD and CP through a randomized controlled trial. METHODS/DESIGN: This is a prospective, double-blind, parallel-arm, randomized controlled trial. The primary outcome is change in quality of life scores between the two arms of the trial at 6 weeks, assessed using the Paediatric Quality of Life Inventory (PedsQL) generic 4.0 and CP 3.0 module. All children will undergo baseline assessment including the Open Questions Inventory, IQI, PedsQL 3.0, PedsQL 4.0 generic, and the Strengths and Difficulties Questionnaire (SDQ). Eligible children with CP aged 4 years to < 16 years will be stratified and blocked by the age groups 4-9 and 10 to < 16 years and by Gross Motor Function Classification System (GMFCS) levels 1-3 and 4-5. Families in the intervention arm will receive tailored insight visual support strategies and telephone calls during the 6-week trial period. The control arm will receive standard treatment and the intervention after the 6-week trial period. Follow-up interviews will be performed in both arms at 6 weeks with a repeat administration of the PedsQL CP 4.0 and 3.0, the IQI and the SDQ. Secondary outcomes include a change in functional vision. DISCUSSION: This randomized controlled trial will provide evidence of the effectiveness of this intervention for children with CP in a resource-poor setting. TRIAL REGISTRATION: Pan African Clinical Trials Registration, PACTR201612001886396 . Registered on 3 December 2016.

PMID: 31291989

18. Turkish Version of the Mastication Observation and Evaluation (MOE) Instrument: A Reliability and Validity Study in Children.
Serel Arslan S, Demir N, Karaduman AA.

Dysphagia. 2019 Jul 10. doi: 10.1007/s00455-019-10035-8. [Epub ahead of print]

The Mastication Observation and Evaluation (MOE) instrument is an objective assessment of the chewing process in children. This study aimed to translate the MOE into Turkish and to test its reliability and validity in children with cerebral palsy (CP). A total of 53 children with CP and 27 typical children were included in the study. The MOE was translated from Dutch into Turkish by using the forward, backward, forward translation method. The internal consistency, intra- and inter-observer reliability, criterion, and discriminant validity of the Turkish version of the MOE (T-MOE) were investigated. Internal consistency was excellent with a Cronbach's alpha value of 0.98. The Intraclass correlation coefficient ranged from 0.89 to 0.97 for intra-rater reliability and from 0.86 to 0.94 for inter-rater reliability. The median score from Karaduman Chewing Performance Scale (KCPS) was 7 (min = 1, max = 8). All of the items in the T-MOE and the total T-MOE score had a negative and strong correlation with the KCPS score. Typical children without chewing disorders had greater T-MOE scores than the children with CP suffering from chewing disorders (p < 0.01). The T-MOE is a reliable and valid instrument for evaluating the observed oral motor behaviors of chewing function in children. It can be used in clinical practice and research.Clinical trial number: NCT03811353.

PMID: 31292728

19. Natural history of silent aspiration on modified barium swallow studies in the pediatric population.
Shay EO, Meleca JB, Anne S, Hopkins B.

Int J Pediatr Otorhinolaryngol. 2019 Jul 2;125:116-121. doi: 10.1016/j.ijporl.2019.06.035. [Epub ahead of print]

OBJECTIVES: To investigate the natural history of silent aspiration in the pediatric population. METHODS: Retrospective chart review of patients (age < 3 years) who underwent modified barium swallow studies (MBSS), between January 1, 2007, to December 31, 2017, were studied to compare comorbidities and determine course of resolution in those with silent aspiration. RESULTS: A total of 148 charts were reviewed. Patients that underwent surgical intervention for laryngeal anomalies causing silent aspiration and those with overt aspiration or oral aversion were excluded. Of the 56 patients in the study, 25 had silent aspiration and 31 demonstrated no silent aspiration on MBSS. There was a higher rate of overall comorbidities amongst silent aspirators (96.0% vs. 48.4%, p=0.003) in comparison to patients with no silent aspiration on MBSS. Silent aspirators had higher rates of cerebral palsy (16.0% vs. 0%, p=0.034), and seizures (36.0% vs. 3.2%, p=0.003). Of the 20 patients with silent aspiration with an MBSS completed beyond the initial one, 13 (65.0%) experienced resolution, 5 (20.0%) did not experience resolution by age 5, and 2 (10.0%) had unknown resolution due to being lost to follow up or not yet reaching age 5. No statistically significant associations were found between comorbidities, gender, presence of a gastrostomy tube and resolution. CONCLUSIONS: Silent aspiration in children is associated with neurological comorbidities, particularly cerebral palsy and seizures. More than half of the patients with silent aspiration spontaneously resolve over time. Expectant management, close surveillance, and clinical assessments can be considered in these patients on an individual basis.

PMID: 31295702

20. Correction: Predicting respiratory hospital admissions in young people with cerebral palsy.
[No authors listed]

Arch Dis Child. 2019 Jul 11. pii: archdischild-2017-314346corr1. doi: 10.1136/archdischild-2017-314346corr1. [Epub ahead of print]

Erratum for Predicting respiratory hospital admissions in young people with cerebral palsy. [Arch Dis Child. 2018]

PMID: 31296595

21. Cost-effectiveness of home mechanical ventilation in children living in a developing country.
Hassani SA, Navaei S, Shirzadi R, Rafiemanesh H, Masiha F, Keivanfar M, Tahernia L, Moazzami B, Azizi G, Aghaali M, Modaresi M.

Anaesthesiol Intensive Ther. 2019;51(1):35-40. doi: 10.5603/AIT.a2019.0006.

BACKGROUND: Home mechanical ventilation is a promising option for children requiring long-term mechanical-assisted ventilation, while data on cost-effectiveness of this approach is limited. AIMS: To investigate the cost-effectiveness of home mechanical ventilation in children requiring long-term mechanical-assisted ventilation. METHODS: A retrospective cohort was conducted on 67 children (32 girls, 47.7%) requiring mechanical-assisted ventilation. Underlying diseases of children were congenital airway malformations in 24, cystic fibrosis in 4, severe laryngomalacia in 16, poly neuropathy syndrome in 6, mitochondrial myopathy in 5, hypoxic ischemic encephalopathy in 6, and cerebral palsy in 2. Children were admitted in pediatric intensive care units (ICU) for 2 weeks. After discharge, they were on home mechanical ventilation and were followed for 1 year. Data on daily costs of admission at ICU, rehospitalizations, weaning, educational performance and muscle strength were gathered. RESULTS: Mean age of children at time of initiation of mechanical-assisted ventilation was 5.8 years (ranged from 2 months to 15 years). Mean number of re-hospitalizations was 3.4_4.9 times with mean duration of 9.44_2.53 days. Of children on mechanical ventilation, 1 attended school, 2 were weaned, and 21 experienced improvement in muscle strength. No fatal or serious complications were observed while children were on home mechanical ventilation. Mean costs of daily ICU admission was 912_1028 $, while the mean daily cost of home mechanical ventilation was 60.86_4.95 $ ($p < 0.001$). CONCLUSIONS: Home mechanical ventilation is more cost-effective compared to ICU admission for only mechanical-assisted ventilation. < p > < /p >.

PMID: 31280550

22. Predictors of Bowel Resection During Nonelective Ladd Procedure for Pediatric Malrotation.
Do WS, Marenco CW, Horton JD, Escobar MA Jr.

J Surg Res. 2019 Jul 3;243:419-426. doi: 10.1016/j.jss.2019.05.052. [Epub ahead of print]

BACKGROUND: The objective of this study was to identify risk factors for bowel resection in a modern cohort of patients undergoing nonelective Ladd procedures. MATERIALS AND METHODS: Retrospective descriptive analysis of patients with Ladd procedure (CPT 44055) in the National Surgical Quality Improvement Program-Pediatric (NSQIP-P) database (2012-2015). Exclusion criteria were elective case, duodenal atresia, or other known congenital anomaly (except cardiac, structural central nervous system, or airway anomaly) and open wounds from prior surgery or drains. Independent variables included all preoperative variables within NSQIP-P. The primary outcome variable was bowel resection as a concurrent procedure. Multivariate analysis was performed by incorporating all independent variables into a stepwise forward logistic regression model to identify independent risk factors for bowel resection. RESULTS: Of 267,289 patients in NSQIP-P, 1284 had a Ladd procedure. Of these, 292 were performed urgently or emergently in children with no known atresias, congenital anomalies, or open wounds. Twenty-nine (10%) had a bowel resection. On univariate analysis, bowel resection rates did not differ by age, weight, prematurity, ventilator dependence, asthma, chronic lung disease, tracheostomy, esophageal or gastrointestinal disease, hepatobiliary or pancreatic disease, cerebral palsy, central nervous system abnormality, neuromuscular disorder, intraventricular hemorrhage, steroid use, hematologic disorder, malignancy, sepsis, inotropic support, or CPR (P = nonsignificant). Higher rates of bowel resection were observed in patients with cardiac risk factors, white blood count (WBC) >15K, oxygen support, nutritional support, and developmental delay ($P < 0.05$). Only cardiac risk factors and WBC >15K were significant on multivariate analysis. CONCLUSIONS: Bowel resections (10% in this cohort of nonelective Ladd procedures) were independently associated with cardiac risk factors and WBC >15K. LEVEL OF EVIDENCE: III.

PMID: 31279268

23. Increased prevalence of osteoarthritis in adults with cerebral palsy.
French ZP, Torres RV, Whitney DG.

OBJECTIVE: Adults with cerebral palsy have an increased risk of developing osteoarthritis. However, little is known about the epidemiology of osteoarthritis among this vulnerable population. The objectives of this study were to compare the prevalence of osteoarthritis between adults with and without cerebral palsy, and to determine how the prevalence of osteoarthritis changes throughout adulthood for each group. DESIGN: Data were extracted from the 2016 Optum Clinformatics® Data Mart, a nationwide database of de-identified US insurance claims, containing medical and pharmacy information on beneficiaries. SUBJECTS: International Classification of Diseases 10th revision (ICD-10) codes were used to identify adults (18+ years) with (n = 7,348) and without (n = 8.7 million) cerebral palsy. METHODS: ICD-10 codes were used to identify osteoarthritis. Prevalence of osteoarthritis was compared between adults with and without cerebral palsy before and after adjusting for age and sex. The prevalence of any type of osteoarthritis was compared between men and women with and without cerebral palsy, stratified by the following age groups: 18-30, 31-40, 41-50, 51-60, 61-70, and > 70 years. RESULTS: Adults with cerebral palsy had higher prevalence and adjusted odds of any, poly, hip, knee, and other/unspecified osteoarthritis (odds ratio (OR): 1.3 -2.1; p < 0.001), but not hand osteoarthritis (OR: 0.86; p = 0.46). Men and women with cerebral palsy had a higher prevalence of any osteoarthritis compared with adults without cerebral palsy across all age groups (all p < 0.05). CONCLUSION: Privately -insured adults with cerebral palsy had a higher prevalence of osteoarthritis compared with adults without cerebral palsy across the adult lifespan.

24. Development and assessment of the feasibility of a Zika family support programme: a study protocol.
Duttine A, Smythe T, Calheiro de Sá MR, Ferrite S, Moreira ME, Kuper H.

The Zika virus outbreak in Brazil in 2015 affected thousands of people. Zika is now known to cause congenital malformations leading to impairments and developmental delays in affected children, including Congenital Zika Syndrome (CZS). Children with CZS have complex care needs. Caregivers require significant levels of support to meet these needs, and there are large gaps in healthcare services. This study aims to develop, pilot and assess the feasibility and scalability of a community-based Family Support Programme for caregivers of children with CZS. The programme is adapted from the Getting to Know Cerebral Palsy (GTKCP) programme for the context of CZS in Brazil. GTKCP is a 10-session programme held with 6-10 caregivers in the local community. It includes practical, educational, peer-support and psychosocial aspects, which aim to improve confidence and capacity to care for a child with CP, and quality of life and empowerment of caregivers. The research project contains four components: Ascertaining need for the caregiver programme: a mixed-methods approach that included two literature reviews, interviews with key stakeholders in country, and incorporation of findings from the Social and Economic Impact of Zika study.Adapting GTKCP for the context of CZS and Brazil: undertaken with guidance from technical experts.Pilot testing the intervention: deliver the 10-session programme to one group of caregivers of children with CZS in Rio de Janeiro and another in Greater Salvador.Update the manual through fast-track learning from participant and facilitator feedback. Assessing the feasibility of the intervention for scale up: deliver the updated programme to two groups each in Rio de Janeiro and Greater Salvador, and evaluate the acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited efficacy, through questionnaires, direct observation, semi-structured interviews and cost calculation. The project has ethics approval in both the UK and Brazil.

25. Prevalence of cerebral palsy with Gross Motor Function Classification System levels IV and V in children in Israel: a cross-cultural comparison.
Blumenfeld O, Ben-Pazi H, Ornoy A, Josef A, Shohat T.

PURPOSE: Cerebral palsy is the most common physical disability in childhood. Our aim was to study the prevalence of wheelchair-dependent cerebral palsy (equivalent to gross motor function classification system level IV/V) among Jewish and Arab children in Israel and to investigate differences between the children of the two population groups. METHODS: Children

diagnosed with cerebral palsy born in the years 2005-2006 were located through the Israel National Insurance Institute database. Demographic and clinical data were retrieved from children's records. RESULTS: Overall prevalence in Israel was 0.8 (0.7-0.9) per 1000 live births. The prevalence was significantly higher among Arabs (1.2:1000) than Jews (0.6:1000; OR = 1.6, 95% CI 1.2-2.1, p = 0.001) and was highest among Arabs in the South (Bedouins) (2.8:1000). Consanguinity among parents and low socioeconomic status were significantly more common among Arab children with wheelchair- dependent cerebral palsy compared with Jews. Higher rates of children with cerebral palsy following term pregnancy were found in Arabs. Extreme preterm births, very low birth weight, and emergent cesarean section were more common among Jews compared with Arabs. CONCLUSIONS: This study revealed population group differences of cerebral palsy with Gross Motor Function Classification System levels IV and V. Higher rates of cerebral palsy, especially following term pregnancy in the Arab population, may be attributed to consanguinity and genetic factors. There is a need to tailor services to underserved population based on etiology: preterm births and genetic causes for the Jewish and Arab populations, respectively.

PMID: 31292758

26. [Cerebral palsy in literature, cinema and television].
Collado-Vazquez S, Carrillo JM.

Rev Neurol. 2019 Jul 16;69(2):77-86. doi: 10.33588/rn.6902.2018428. [Article in Spanish; Abstract available in Spanish from the publisher]

INTRODUCTION: Cerebral palsy is defined as a group of developmental disorders affecting movement and posture that limit a person's activity. They due to non-progressive alterations that occurred in the developing foetal or infant brain in the early years of life and are often accompanied by epilepsy and cognitive, sensory, communication or behavioural disorders. Cerebral palsy has been portrayed in literature, cinema and television, and this study aims to explore how it has been represented in these media. DEVELOPMENT: Cerebral palsy has frequently been represented in literature, cinema and television and with varying degrees of realism. The symptoms, the experiences of patients, relatives and caregivers, treatments, supporting products, architectural barriers or social and labour relations have all been portrayed. Sometimes they have been represented in a way that is very close to reality, while in other cases the most dramatic aspects have been amplified to add to the plot. CONCLUSIONS: Cerebral palsy has been widely represented in works of fiction and testimonies, comics, films, short films, documentaries and television series, sometimes in a very realistic way, while in others it has been done in a way that may increase the stigma surrounding this condition by offering a distorted vision of reality. Nevertheless, in any event they have helped to make this condition more visible.

PMID: 31287151

27. Cerebral Palsy.
Green MM, Gaebler-Spira D.

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