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NEWS
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Monday 27 March 2017

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# Interventions and Management

**1. Unimanual versus bimanual therapy in children with unilateral cerebral palsy: Same, same, but different.**

Hoare B, Greaves S.

J Pediatr Rehabil Med. 2017;10(1):47-59. doi: 10.3233/PRM-170410.

BACKGROUND: There is high-level evidence supporting constraint-induced movement therapy (CIMT) and bimanual therapy for children with unilateral cerebral palsy. Evidence-based intervention includes time-limited, goal-directed, skills-based, intensive blocks of practice based on motor learning theory. AIM AND METHODS: Using supporting literature and clinical insight, we provide a theoretical rationale to highlight previously unreported differences between CIMT and bimanual therapy. DISCUSSION: The current emphasis on total dosage of practice for achieving positive outcomes fails to recognise the influence of other critical concepts within motor learning. Limitations exist in the application of motor learning principles using CIMT due to its unimanual nature. CIMT is effective for development of unimanual actions brought about by implicit learning, however it is difficult to target explicit learning that is required for learning how to use two hands together. Using bimanual therapy, object properties can be adapted to trigger goal-related perceptual and cognitive processes required for children to learn to recognise when two hands are required for task completion. CONCLUSION: CIMT and bimanual should be viewed as complementary. CIMT could be used to target unimanual actions. Once these actions are established, bimanual therapy could be used for children to learn how to use these actions for bimanual skill development.

PMID: 28339410

**2. Hand Function in a Population-Based Sample of Young Children with Unilateral or Bilateral Cerebral Palsy.**

Klevberg GL, Østensjø S, Krumlinde-Sundholm L, Elkjær S, Jahnsen RB.

Phys Occup Ther Pediatr. 2017 Mar 20:1-13. doi: 10.1080/01942638.2017.1280873. [Epub ahead of print]

AIM: To describe aspects of hand function in a population-based sample of young children with clinical signs of unilateral or bilateral cerebral palsy (CP). METHOD: A cross-sectional study with data from national CP registers in Norway. Manual ability was classified with the Manual Ability Classification System (MACS) or Mini-MACS. Hand use in bimanual activities was measured with the Assisting Hand Assessment (AHA) for unilateral CP or the newly developed Both Hands Assessment (BoHA) for bilateral CP. RESULTS: From 202 children, 128 (57 females) were included (Mini-MACS/MACS levels I-V, mean age 30.4 months; SD = 12.1). Manual abilities were distributed across levels I-III in unilateral CP and levels I-V in bilateral CP. Variations in AHA and BoHA units were large. One-way ANOVA revealed associations between higher AHA or BoHA units and Mini-MACS/MACS levels of higher ability ($p < 0.01$) and higher age ($p < 0.04$). CONCLUSIONS: Compared with young children with unilateral CP, children with bilateral CP showed greater variation in Mini-MACS/MACS levels, and both sub-groups showed large variations in AHA or BoHA units. The classifications and assessments used in this

study are useful to differentiate young children's ability levels. Such information is important to tailor upper limb interventions to the specific needs of children with CP.

PMID: 28318401

**3. Rationale for prescription, and effectiveness of, upper limb orthotic intervention for children with cerebral palsy: a systematic review.**

Garbellini S, Robert Y, Randall M, Elliott C, Imms C.

Disabil Rehabil. 2017 Mar 12:1-11. doi: 10.1080/09638288.2017.1297498. [Epub ahead of print]

PURPOSE: To explore (i) reasons for upper limb orthosis prescription for children with cerebral palsy (CP), (ii) the link between reason and effect according to intended outcome and outcome measure utilized and (iii) to classify the prescribed orthoses using standard terminology. METHOD: A prospectively registered (center for reviews and dissemination: 42015022067) systematic review searched for experimental and observational studies investigating rigid/thermoplastic upper limb orthotic intervention for children aged 0-18 with CP. The Cochrane central register, MEDLINE, CINAHL, Embase, SCOPUS and Web of Science databases were searched. Included studies were assessed for risk of bias. RESULTS: Sixteen studies met selection criteria. Two studies described a specific reason for orthosis prescription, six prescribed orthoses to manage a clinical symptom and eight did not describe a reason. Eight studies were analyzed for effect according to intended outcome with no clear connection found between reasons for prescription, outcome measures utilized and effect reported. INTERPRETATION: The lack of evidence for upper limb orthotic intervention for children with CP leads to uncertainty when considering this treatment modality. Future research is needed to evaluate the effect of orthosis wear in relation to intended outcome utilizing robust methods and valid and reliable outcome measures. Implications for rehabilitation: Insufficient evidence exists about the reason for prescription of upper limb orthoses. The connection between reason for orthosis prescription, intended outcome, outcome measure utilized and observed effect is unclear. Recommend orthosis prescription to be accompanied by clear documentation of the aim of the orthosis and description using orthosis classification system terminology. Outcome measures consistent with the reason for orthosis prescription and intended outcome of the intervention are essential to measure effectiveness of the intervention.

PMID: 28286982

**4. Upper extremity muscle activation in children with unilateral cerebral palsy during an auditory cued repetitive task: Effects on bimanual coordination.**

Charles J.

J Pediatr Rehabil Med. 2017;10(1):19-26. doi: 10.3233/PRM-170407.

PURPOSE: The aim of this exploratory study was to investigate mirror muscle activation in the upper limbs of children with unilateral cerebral palsy during an auditory-cued repetitive squeezing task and to compare upper limb muscle activation patterns to typically developing peers engaged in the same task. METHODS: A convenience sample of six children with unilateral cerebral palsy and six typically developing peers (7-17 y) participated in the study. Muscle activity was measured using a 16 channel Zerowire EMG system (Noraxon, USA Inc. Scottsdale, AZ) in the anterior deltoid, biceps brachii, extensor carpi radialis, flexor carpi radialis, and lateral triceps muscles bilaterally as children squeezed a pediatric bulb dynamometer to 3 pounds per square inch (PSI) for a one second duration, 10 times in one minute. Squeezing activity was cued by a computer generated auditory beep. Between hand differences in muscle onset times and onset amplitude for each muscle were determined using paired t-tests. Two group by two hand ANOVA measured between group differences. RESULTS: Results supported increased later muscle onset and lack of significant differences in onset amplitude bilaterally when the dominant hand was working in the CP population. CONCLUSIONS: There are differences in motor control mechanisms of muscle activation between populations.

PMID: 28339407

**5. Parameters and Measures in Assessment of Motor Learning in Neurorehabilitation; A Systematic Review of the Literature.**

Shishov N, Melzer I, Bar-Haim S.

Front Hum Neurosci. 2017 Feb 24;11:82. doi: 10.3389/fnhum.2017.00082. eCollection 2017.

Upper limb function, essential for daily life, is often impaired in individuals after stroke and cerebral palsy (CP). For an improved upper limb function, learning should occur, and therefore training with motor learning principles is included in many rehabilitation interventions. Despite accurate measurement being an important aspect for examination and optimization of treatment outcomes, there are no standard algorithms for outcome measures selection. Moreover, the ability of the chosen measures to identify learning is not well established. We aimed to review and categorize the parameters and measures utilized for identification of motor learning in stroke and CP populations. PubMed, Pedro, and Web of Science databases were systematically searched between January 2000 and March 2016 for studies assessing a form of motor learning following upper extremity training using motor control measures. Thirty-two studies in persons after stroke and 10 studies in CP of any methodological quality were included. Identified outcome measures were sorted into two categories, "parameters," defined as identifying a form of learning, and "measures," as tools measuring the parameter. Review's results were organized as a narrative synthesis focusing on the outcome measures. The included studies were heterogeneous in their study designs, parameters and measures. Parameters included adaptation (n = 6), anticipatory control (n = 2), after-effects (n = 3), de-adaptation (n = 4), performance (n = 24), acquisition (n = 8), retention (n = 8), and transfer (n = 14). Despite motor learning theory's emphasis on long-lasting changes and generalization, the majority of studies did not assess the retention and transfer parameters. Underlying measures included kinematic analyses in terms of speed, geometry or both (n = 39), dynamic metrics, measures of accuracy, consistency, and coordination. There is no exclusivity of measures to a specific parameter. Many factors affect task performance and the ability to measure it-necessitating the use of several metrics to examine different features of movement and learning. Motor learning measures' applicability to clinical setting can benefit from a treatment-focused approach, currently lacking. The complexity of motor learning results in various metrics, utilized to assess its occurrence, making it difficult to synthesize findings across studies. Further research is desirable for development of an outcome measures selection algorithm, while considering the quality of such measurements.

PMID: 28286474

**6. Interactive wearable systems for upper body rehabilitation: a systematic review.**

Wang Q, Markopoulos P, Yu B, Chen W, Timmermans A.

J Neuroeng Rehabil. 2017 Mar 11;14(1):20. doi: 10.1186/s12984-017-0229-y.

BACKGROUND: The development of interactive rehabilitation technologies which rely on wearable-sensing for upper body rehabilitation is attracting increasing research interest. This paper reviews related research with the aim: 1) To inventory and classify interactive wearable systems for movement and posture monitoring during upper body rehabilitation, regarding the sensing technology, system measurements and feedback conditions; 2) To gauge the wearability of the wearable systems; 3) To inventory the availability of clinical evidence supporting the effectiveness of related technologies. METHOD: A systematic literature search was conducted in the following search engines: PubMed, ACM, Scopus and IEEE (January 2010-April 2016). RESULTS: Forty-five papers were included and discussed in a new cuboid taxonomy which consists of 3 dimensions: sensing technology, feedback modalities and system measurements. Wearable sensor systems were developed for persons in: 1) Neuro-rehabilitation: stroke (n = 21), spinal cord injury (n = 1), cerebral palsy (n = 2), Alzheimer (n = 1); 2) Musculoskeletal impairment: ligament rehabilitation (n = 1), arthritis (n = 1), frozen shoulder (n = 1), bones trauma (n = 1); 3) Others: chronic pulmonary obstructive disease (n = 1), chronic pain rehabilitation (n = 1) and other general rehabilitation (n = 14). Accelerometers and inertial measurement units (IMU) are the most frequently used technologies (84% of the papers). They are mostly used in multiple sensor configurations to measure upper limb kinematics and/or trunk posture. Sensors are placed mostly on the trunk, upper arm, the forearm, the wrist, and the finger. Typically sensors are attachable rather than embedded in wearable devices and garments; although studies that embed and integrate sensors are increasing in the last 4 years. 16 studies applied knowledge of result (KR) feedback, 14 studies applied knowledge of performance (KP) feedback and 15 studies applied both in various modalities. 16 studies have conducted their evaluation with patients and reported usability tests, while only three of them conducted clinical trials including one randomized clinical trial. CONCLUSIONS: This review has shown that wearable systems are used mostly for the monitoring and provision of feedback on posture and upper extremity movements in stroke rehabilitation. The results indicated that accelerometers and IMUs are the most frequently used sensors, in most cases attached to the body through ad hoc contraptions for the purpose of improving range of motion and movement performance during upper body rehabilitation. Systems featuring sensors embedded in wearable appliances or garments are only beginning to emerge. Similarly, clinical evaluations are scarce and are further needed to provide evidence on effectiveness and pave the path towards implementation in clinical settings.

PMID: 28284228

**7. Extrinsic feedback and upper limb motor skill learning in typically-developing children and children with cerebral palsy: Review.**

Robert MT, Sambasivan K, Levin MF.

Restor Neurol Neurosci. 2017;35(2):171-184. doi: 10.3233/RNN-160688.

BACKGROUND: Improvment of upper limb motor skills occurs through motor learning that can be enhanced by providing extrinsic feedback. Different types and frequencies of feedback are discussed but specific guidelines for use of feedback for motor learning in typically-developing (TD) children and children with Cerebral Palsy (CP) are not available. OBJECTIVE: Identify the most effective modalities and frequencies of feedback for improving upper limb motor skills in TD children and children with CP. METHODS: Ovid MEDLINE, Cochrane, PEDro and PubMed-NCBI were searched from 1950 to December 2015 to identify English-language articles addressing the role of extrinsic feedback on upper limb motor learning in TD children and children with CP. Nine studies were selected with a total of 243 TD children and 102 children with CP. Study quality was evaluated using the Downs and Black scale and levels of evidence were determined with Sackett's quality ratings. RESULTS: There was a lack of consistency in the modalities and frequencies of feedback delivery used to improve motor learning in TD children and in children with CP. Moreover, the complexity of the task to be learned influenced the degree of motor learning achieved. CONCLUSION: A better understanding of the influence of feedback on motor learning is needed to optimize motor skill acquisition in children with CP.

PMID: 28282845

**8. Upper limb kinematics of adults with cerebral palsy on bilateral functional tasks.**

Lott C, Johnson MJ.

Conf Proc IEEE Eng Med Biol Soc. 2016 Aug;2016:5676-5679. doi: 10.1109/EMBC.2016.7592015.

Adults with cerebral palsy (CP) often show upper limb impairments which impact their ability to execute activities of daily living (ADLs). Three adults with CP and five healthy adults performed three types of bilateral and unilateral ADLs: drink, pour, and pick and place tasks. An affordable bilateral assessment system (BiAS) was used to measure wrist kinematic trajectories. Four metrics, total completion time, maximum velocity, smoothness, and phase difference, were used to evaluate each functional task. Overall, adults with CP took a longer time than the healthy subjects to complete all unilateral functional tasks with their non-dominant hand. Moreover, while the healthy controls had similar mean velocities in the dominant and non-dominant hands during the bilateral tasks, adults with CP typically exhibited slower mean velocities in the dominant hand during the bilateral tasks than during the unilateral dominant tasks. Similar to existing literature, we found that adults with CP compensated by slowing the dominant arm to match the non-dominant arm in order to complete the tasks, showing the importance of utilizing bilateral training in upper limb rehabilitation treatments.

PMID: 28269543

**9. Does intensive upper limb treatment modality Hybrid Constrained Induced Movement Therapy (H-CIMT) improve grip and pinch strength or fatigability of the affected hand?**

Brauers L, Geijen MM, Speth LA, Rameckers EA.

J Pediatr Rehabil Med. 2017;10(1):11-17. doi: 10.3233/PRM-170406.

PURPOSE: To investigate the effects of Hybrid-Constrained Induced Movement Therapy (H-CIMT), defined as CIMT combined with Bimanual Intensive Movement Therapy (BIMT), on grip and pinch strength and fatigability we measured grip and pinch strength and fatigability during clinical H-CIMT. METHODS: The children participated in a H-CIMT model organized in a therapeutic summer-camp. Children received 90 hours of intensive treatment. Grip and pinch strength and fatigability was measured and fatigue was calculated according to a Static Fatigue Index (SFI). RESULTS: Pinch strength significantly increased, grip strength did not increase significantly. A non-significant decrease was seen in SFI in pinch and grip. CONCLUSIONS: H-CIMT showed to be effective in increasing muscle pinch strength in the AH. Effectiveness in decreasing muscle fatigue during grip and pinch tests is not yet shown although there was a tendency towards a decrease in muscle fatigue. However, the long-term effects on these aspects are also important in future research.

PMID: 28339406

**10. Practice-based evidence from a clinical cohort that received pediatric constraint- induced movement therapy.**

DeLuca SC, Trucks MR, Wallace DA, Ramey SL.

J Pediatr Rehabil Med. 2017;10(1):37-46. doi: 10.3233/PRM-170409.

PURPOSE: Constraint-Induced Movement Therapy (CIMT) is now designated a highly efficacious treatment for children with cerebral palsy, based on rigorous clinical trials. Yet virtually no evidence confirms that these moderate to large size effects can be replicated in clinical practice for a more heterogeneous clinical population. Thus there is a need to collect and report treatment outcome data based on actual clinical practice as a critical next step for implementation. METHODS: This study presents results from a prospective study conducted on a clinical cohort of 88 children, 18 months to 12 years old (M = 55 months, SD = 5 months), who received high-intensity CIMT known as ACQUIREc. The children varied in severity and etiology of their hemiparesis and a subset was diagnosed with asymmetric quadriparesis. RESULTS: Pre- to post-CIMT assessments confirmed highly significant and clinically meaningful changes based on both parental report (Pediatric Motor Activity Log, $p < 0.0001$) and standardized measures (The Assisting Hand Assessment, $p = 0.04$). CONCLUSIONS: Clinical practice of high-intensity CIMT (120 hours in 4 weeks) with full-time casting of the less-impaired upper extremity produced benefits of comparable magnitude to those from rigorous randomized controlled trials (RCTs). Therapists were highly trained and actively monitored. Children across a wide range of etiologies and severity levels realized positive outcomes.

PMID: 28339409

**11. Exploring the feasibility and use of acceleromters before, during, and after a camp-based CIMT program for children with cerebral palsy.**

Coker-Bolt P, Downey RJ, Connolly J, Hoover R, Shelton D, Seo NJ.

J Pediatr Rehabil Med. 2017;10(1):27-36. doi: 10.3233/PRM-170408.

PURPOSE: The aim of this pilot study was to determine the feasibility and use accelerometers before, during, and after a camp -based constraint-induced movement therapy (CIMT) program for children with hemiplegic cerebral palsy. METHODS: A pre-test post-test design was used for 12 children with CP (mean = 4.9 yrs) who completed a 30-hour camp-based CIMT program. The accelerometer data were collected using ActiGraph GT9X Link. Children wore accelerometers on both wrists one day before and after the camp and on the affected limb during each camp day. Three developmental assessments were administered pre-post CIMT program. RESULTS: Accelerometers were successfully worn before, during, and directly after the CIMT program to collect upper limb data. Affected upper limb accelerometer activity significantly increased during the CIMT camp compared to baseline ($p < 0.05$). Significant improvements were seen in all twelve children on all assessments of affected upper limb function ($p < 0.05$) measuring capacity and quality of affected upper limb functioning. CONCLUSION: Accelerometers can be worn during high intensity pediatric CIMT programs to collect data about affected upper limb function. Further study is required to determine the relationship between accelerometer data, measure of motor capacity, and real-world performance post -CIMT.

PMID: 28339408

**12. Control of Walking Speed in Children With Cerebral Palsy.**

Davids JR, Cung NQ, Chen S, Sison-Williamson M, Bagley AM.

J Pediatr Orthop. 2017 Mar 21. doi: 10.1097/BPO.0000000000000978. [Epub ahead of print]

BACKGROUND: Children's ability to control the speed of gait is important for a wide range of activities. It is thought that the ability to increase the speed of gait for children with cerebral palsy (CP) is common. This study considered 3 hypotheses: (1) most ambulatory children with CP can increase gait speed, (2) the characteristics of free (self-selected) and fast walking are related to motor impairment level, and (3) the strategies used to increase gait speed are distinct among these levels. METHODS: A retrospective review of time-distance parameters (TDPs) for 212 subjects with CP and 34 typically developing subjects walking at free and fast speeds was performed. Only children who could increase their gait speed above the minimal clinically important difference were defined as having a fast walk. Analysis of variance was used to compare TDPs of children with CP, among Gross Motor Function Classification System (GMFCS) levels, and children in typically developing group.

RESULTS: Eight-five percent of the CP group (GMFCS I, II, III; 96%, 99%, and 34%, respectively) could increase gait speed on demand. At free speed, children at GMFCS I and II were significantly faster than children at GMFCS level III. At free speed, children at GMFCS I and II had significantly greater stride length than those at GMFCS levels III. At free speed, children at GMFCS level III had significantly lower cadence than those at GMFCS I and II. There were no significant differences in cadence among GMFCS levels at fast speeds. There were no significant differences among GMFCS levels for percent change in any TDP between free and fast walking. DISCUSSION: Almost all children with CP at GMFCS levels I and II can control the speed of gait, however, only one-third at GMFCS III level have this ability. This study suggests that children at GMFCS III level can be divided into 2 groups based on their ability to control gait speed; however, the prognostic significance of such categorization remains to be determined.

PMID: 28328565

**13. Children with moderate to severe cerebral palsy may not benefit from stochastic vibration when developing independent sitting.**

Kyvelidou A, Harbourne RT, Haworth J, Schmid KK, Stergiou N.

Dev Neurorehabil. 2017 Mar 9:1-9. doi: 10.1080/17518423.2017.1290705. [Epub ahead of print]

PURPOSE: Determine sitting postural control changes for children with cerebral palsy (CP), using a perceptual-motor intervention and the same intervention plus stochastic vibration through the sitting surface. METHODS: Two groups of children with moderate or severe CP participated in the 12 week interventions. The primary outcome measure was center of pressure data from which linear and nonlinear variables were extracted and the gross motor function measure (GMFM). RESULTS: There were no significant main effects of intervention or time or an interaction. Both treatment groups increased the Lyapunov exponent values in the medial-lateral direction three months after the start of treatment as well as their GMFM scores in comparison with baseline. CONCLUSIONS: The stochastic vibration did not seem to advance the development of sitting postural control in children between the ages of 2 and 6 years. However, perceptual-motor intervention was found beneficial in advancing sitting behavior.

PMID: 28277811

**14. Position Between Trunk and Pelvis During Gait Depending on the Gross Motor Function Classification System.**

Sanz-Mengibar JM, Altschuck N, Sanchez-de-Muniain P, Bauer C, Santonja-Medina F.

Pediatr Phys Ther. 2017 Apr;29(2):130-137. doi: 10.1097/PEP.0000000000000361.

PURPOSE: To understand whether there is a trunk postural control threshold in the sagittal plane for the transition between the Gross Motor Function Classification System (GMFCS) levels measured with 3-dimensional gait analysis. METHOD: Kinematics from 97 children with spastic bilateral cerebral palsy from spine angles according to Plug-In Gait model (Vicon) were plotted relative to their GMFCS level. RESULTS: Only average and minimum values of the lumbar spine segment correlated with GMFCS levels. Maximal values at loading response correlated independently with age at all functional levels. Average and minimum values were significant when analyzing age in combination with GMFCS level. CONCLUSION: There are specific postural control patterns in the average and minimum values for the position between trunk and pelvis in the sagittal plane during gait, for the transition among GMFCS I-III levels. Higher classifications of gross motor skills correlate with more extended spine angles.

PMID: 28319490

**15. Inter and Intra Rater Reliability of the 10 Meter Walk Test in the Community Dweller Adults with Spastic Cerebral Palsy.**

Bahrami F, Noorizadeh Dehkordi S, Dadgoo M.

Iran J Child Neurol. 2017 Winter;11(1):57-64.

OBJECTIVE: We aimed to investigation the intra-rater and inter-raters reliability of the 10 meter walk test (10 MWT) in adults with spastic cerebral palsy (CP). MATERIALS & METHODS: Thirty ambulatory adults with spastic CP in the summer of 2014 participated (19 men, 11 women; mean age 28 ± 7 yr, range 18- 46 yr). Individuals were non-randomly selected by convenient sampling from the Ra'ad Rehabilitation Goodwill Complex in Tehran, Iran. They had GMFCS levels below IV (I, II, and III). Retest interval for inter-raters study lasted a week. During the tests, participants walked with their maximum speed. Intraclass correlation coefficients (ICC) estimated reliability. RESULTS: The 10 MWT ICC for intra-rater was 0.98 (95% confidence interval (CI) 0.96-0.99) for participants, and >0.89 in GMFCS subgroups (95% confidence interval (CI) lower bound>0.67). The 10 MWT inter-raters' ICC was 0.998 (95% confidence interval (CI) 0/996-0/999), and >0.993 in GMFCS subgroups (95% confidence interval (CI) lower bound>0.977). Standard error of the measurement (SEM) values for both studies was small (0.02< SEM< 0.07). CONCLUSION: Excellent intra-rater and inter-raters reliability of the 10 MWT in adults with CP, especially in the moderate motor impairments (GMFCS level III), indicates that this tool can be used in clinics to assess the results of interventions.

PMID: 28277557

**16. The Differential Effect of Arm Movements during Gait on the Forward Acceleration of the Centre of Mass in Children with Cerebral Palsy and Typically Developing Children.**

Meyns P, Molenaers G, Duysens J, Jonkers I.

Front Hum Neurosci. 2017 Mar 1;11:96. doi: 10.3389/fnhum.2017.00096. eCollection 2017.

Background: We aimed to study the contribution of upper limb movements to propulsion during walking in typically developing (TD) children (n = 5) and children with hemiplegic and diplegic cerebral palsy (CP; n = 5 and n = 4, respectively). Methods: Using integrated three-dimensional motion capture data and a scaled generic musculoskeletal model that included upper limbs, we generated torque driven simulations of gait in OpenSim. Induced acceleration analyses were then used to determine the contributions of the individual actuators located at the relevant degrees of freedoms of the upper and lower limb joints to the forward acceleration of the COM at each time point of the gait simulation. The mean values of the contribution of the actuators of upper limbs, lower limbs, and gravity in different phases of the gait cycle were compared between the three groups. Findings: The results indicated a limited contribution of the upper limb actuators to COM forward acceleration compared to the contribution of lower limbs and gravity, in the three groups. In diplegic CP, the contribution of the upper limbs seemed larger compared to TD during the preswing and swing phases of gait. In hemiplegic CP, the unaffected arm seemed to contribute more to COM deceleration during (pre)swing, while the affected side contributed to COM acceleration. Interpretation: These findings suggest that in the presence of lower limb dysfunction, the contribution of the upper limbs to forward propulsion is altered, although they remain negligible compared to the lower limbs and gravity.

PMID: 28298890

**17. Energy cost during walking in association with age and body height in children and young adults with cerebral palsy.**

Bolster EA, Balemans AC, Brehm MA, Buizer A, Dallmeijer AJ.

Gait Posture. 2017 Feb 27;54:119-126. doi: 10.1016/j.gaitpost.2017.02.026. [Epub ahead of print]

AIM: This cross-sectional study into children and young adults with cerebral palsy (CP) aimed to assess the association of gross energy cost (EC), net EC and net nondimensional (NN) EC during walking with age and body height, compared to typically developing (TD) peers. METHOD: Data was collected in 128 participants with CP (mean age 11y9mo; GMFCS I,n=48; II,n=56; III, n=24) and in 63 TD peers (mean age 12y5mo). Energy cost was assessed by measuring the oxygen consumption during over-ground walking at comfortable speed. Outcome measures derived from the assessment included the

gross and net EC, and NN EC. Differences between the groups in the association between gross, net and NN EC with age and body height, were investigated with regression analyses and interaction effects ($p<0.05$). RESULTS: Interaction effects for age and body height by group were not significant, indicating similar associations for gross, net and NN EC with age or body height among groups. The models showed a significant decline for gross, net and NN EC with increasing age per year (respectively -0.201Jkg-1·m-1; -0.073Jkg-1m-1; -0.007) and body height per cm (respectively -0.057Jkg-1m-1; -0.021Jkg-1m-1; -0.002). INTERPRETATION: Despite higher gross and net EC values for CP compared to TD participants , similar declines in EC outcomes can be expected with growth for participants aged 4-22 years with CP. All energy cost outcomes showed a decline with growth, indicating that correcting for this decline is required when evaluating changes in gross EC, and, to a lesser extent, in net and NN EC in response to treatment or from natural course over time.

PMID: 28288332

**18. Achilles tendon moment arm length is smaller in children with cerebral palsy than in typically developing children.**

Kalkman BM, Bar-On L, Cenni F, Maganaris CN, Bass A, Holmes G, Desloovere K, Barton GJ, O'Brien TD.

J Biomech. 2017 Mar 3. pii: S0021-9290(17)30128-8. doi: 10.1016/j.jbiomech.2017.02.027. [Epub ahead of print]

When studying muscle and whole-body function in children with cerebral palsy (CP), knowledge about both internal and external moment arms is essential since they determine the mechanical advantage of a muscle over an external force. Here we asked if Achilles tendon moment arm (MAAT) length is different in children with CP and age-matched typically developing (TD) children, and if MAAT can be predicted from anthropometric measurements. Sixteen children with CP (age: 10y 7m±3y, 7 hemiplegia, 12 diplegia, GMFCS level: I (11) and II (8)) and twenty TD children (age: 10y 6m±3y) participated in this case-control study. MAAT was calculated at 20° plantarflexion by differentiating calcaneus displacement with respect to ankle angle. Seven anthropometric variables were measured and related to MAAT. We found normalized MAAT to be 15% (~7mm) smaller in children with CP compared to TD children ($p=0.003$). MAAT could be predicted by all anthropometric measurements with tibia length explaining 79% and 72% of variance in children with CP and TD children, respectively. Our findings have important implications for clinical decision making since MAAT influences the mechanical advantage about the ankle, which contributes to movement function and is manipulated surgically.

PMID: 28318605

**19. Effects of elastic therapeutic taping on motor function in children with motor impairments: a systematic review.**

Cunha AB, Lima-Alvarez CD, Rocha AC, Tudella E.

Disabil Rehabil. 2017 Mar 22:1-9. doi: 10.1080/09638288.2017.1304581. [Epub ahead of print]

BACKGROUND: The elastic therapeutic taping has been considered a promising resource for disabled children. OBJECTIVE: To systematically review the evidence of the effects of elastic therapeutic taping on motor function in children with motor impairments. METHOD: Three independent evaluators conducted searches in electronic databases (MEDLINE/PubMed, Scopus, LILACS, BIREME/BVS, Science Direct, SciELO, and PEDro). Clinical studies design, published until 2016, involving elastic therapeutic taping and children aged 0-12 years with motor impairments were included. The variables considered were the methodological aspects (study design, participants, outcome measurements, and experimental conditions); results presented in the studies, and also the methodological quality of studies. RESULTS: Final selection was composed by 12 manuscripts (five randomized controlled trials), published in the last 10 years. Among them, cerebral palsy (CP) was the most recurrent disorder (n = 7), followed by congenital muscular torticollis (n = 2) and brachial plexus palsy (n = 2). Positive results were associated with taping application: improvement in the upper limb function, gross motor skills, postural control, muscular balance, and performance in the dynamics functional and daily activities. LIMITATIONS: Lower quality of the studies, clinical and population heterogeneity existed across studies. CONCLUSIONS: The elastic therapeutic taping has been shown to be a promising adjunct resource to the conventional rehabilitation in children with motor impairments. However, high methodological studies about its efficacy in this population are already scarce. Implications for Rehabilitation Elastic therapeutic taping has been shown to be a promising adjunct resource to the conventional rehabilitation in disabled children. Clinical trials have indicated improvement in the postural control and functional activities with both, upper and lower limbs, and increase in the functional independency resulting from the taping use. Randomized control trials and well-established protocols are needed to increase the confidence in applying elastic therapeutic taping to specific clinical conditions.

PMID: 28325096

**20. Efficacy of Intensive Neurodevelopmental Treatment for Children With Developmental Delay, With or Without Cerebral Palsy.**

Lee KH, Park JW, Lee HJ, Nam KY, Park TJ, Kim HJ, Kwon BS.

Ann Rehabil Med. 2017 Feb;41(1):90-96. doi: 10.5535/arm.2017.41.1.90. Epub 2017 Feb 28.

OBJECTIVE: To evaluate the effectiveness of intensive neurodevelopmental treatment (NDT) on gross motor function for the children having developmental delay (DD), with or without cerebral palsy (CP). METHODS: Forty-two children had intensive NDT three times weekly, 60 minutes a day, for 3 months, immediately followed by conventional NDT once or twice a week, 30 minutes a day, for another 3 months. We assessed Gross Motor Function Measure (GMFM) over three time points: before conventional NDT, before and after intensive NDT, and after 3 months of additional conventional NDT. RESULTS: The GMFM score in DD children significantly improved after intensive NDT, and the improvement maintained after 3 months of conventional NDT ($p<0.05$). The children were further divided into two groups: DD with CP and DD without CP. Both groups showed significant improvement and maintained the improvements, after intensive NDT ($p<0.05$). Also, there was no significant difference in treatment efficacy between the two groups. When we calculate the absence rate for comparing the compliance between intensive and conventional NDT, the absence rate was lower during the intensive NDT. CONCLUSION: Intensive NDT showed significantly improved gross motor function and higher compliance than conventional NDT. Additionally, all improvements were maintained through subsequent short-term conventional NDT. Thus, we recommend the intensive NDT program by day-hospital centers for children with DD, irrespective of accompanying CP.

PMID: 28289640

**21. The efficacy of interventions to increase physical activity participation of children with cerebral palsy: a systematic review and meta-analysis.**

Reedman S, Boyd RN, Sakzewski L.

Dev Med Child Neurol. 2017 Mar 20. doi: 10.1111/dmcn.13413. [Epub ahead of print]

AIM: To determine efficacy of therapy and behaviour change interventions to increase the level of participation in leisure-time physical activities (LTPAs) and habitual physical activity in children and young people with cerebral palsy. METHOD: Five databases were systematically searched. Included studies were randomized or comparison designs. Methodological quality was assessed with a modified Downs and Black Scale. Quantitative analysis was performed using RevMan 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Intervention components and behaviour change constructs were mapped against (1) the International Classification of Functioning, Disability and Health (ICF) and (2) the Theoretical Domains Framework. RESULTS: Searches yielded 2487 unique articles. Eight studies (nine articles) were included. Interventions included physical training, activity level training, combined physical training and behaviour change therapy, online behaviour change modules, and context-focused therapy. Study quality varied from moderate to high. There was a small, significant effect of physical activity intervention compared with passive usual care on level of habitual physical activity, of approximately 1000 additional steps per day (standardized mean difference 0.34, 95% confidence interval 0.03-0.66, $p=0.030$). There was no significant effect on LTPA participation (standardized mean difference 0.40, 95% confidence interval -0.40 to 1.19, $p=0.330$). INTERPRETATION: Therapy and behaviour change interventions have the potential to increase LTPA participation of children and young people with cerebral palsy, although there is a need to depart from impairment-focused approaches. Inappropriate selection of outcomes and inadequate reporting of complex interventions are barriers to progress in this field.

PMID: 28318009

**22. Lumbar translaminar fenestration for insertion of intrathecal baclofen catheter: a novel technique.**

Heran MK, Al-Shikarchy H, Chowne C.

Pediatr Radiol. 2017 Mar 20. doi: 10.1007/s00247-017-3816-y. [Epub ahead of print]

Intrathecal baclofen has long been known to be an efficacious treatment of spasticity in children with cerebral palsy. Test bolus administration is often necessary to ensure patients will benefit from this treatment. The introduction of a intrathecal catheter for test bolus administration can prove challenging in a subset of this population, particularly those who have received surgery with postoperative spinal fusion masses. We outline a novel technique of inserting a spinal catheter for test bolus administration in a patient with a postoperative fusion mass whereby a fenestration is created through the lamina using an osteotomy needle.

PMID: 28317070

**23. Total Hip Arthroplasty in Patients with Cerebral Palsy: A Cohort Study Matched to Patients with Osteoarthritis.**

Houdek MT, Watts CD, Wyles CC, Trousdale RT, Milbrandt TA, Taunton MJ.

J Bone Joint Surg Am. 2017 Mar 15;99(6):488-493. doi: 10.2106/JBJS.16.00528.

BACKGROUND: The spasticity and increased muscle tone observed in patients with cerebral palsy can lead to hip degeneration, subluxation, and pain. Currently, there is hesitation to perform total hip arthroplasty in patients with cerebral palsy because of fears of early wear and dislocation. The purpose of this study was to review the outcomes of total hip arthroplasty in patients with cerebral palsy and to compare outcomes with those of matched patients with a diagnosis of osteoarthritis. METHODS: Over a 24-year period, 39 patients undergoing a total hip arthroplasty with a diagnosis of cerebral palsy were identified. The cohort included 26 male patients (67%), and the mean patient age was 49 years. The mean follow-up was 7 years. Patients with cerebral palsy were matched 1:2 with a group of patients undergoing total hip arthroplasty for osteoarthritis. RESULTS: There was no difference in the rate of reoperation, implant survival, or complications, specifically dislocation. Prior to the surgical procedure, all patients had severe or moderate pain, and postoperatively no patient had moderate or severe pain. Twenty-three patients had an improvement in their ability to independently walk, and all preoperative hip flexion contractures were corrected (n = 9). There was also a significant improvement ($p < 0.0001$) in functional Harris hip scores. CONCLUSIONS: This study refutes previous evidence showing increased risk of complications following total hip arthroplasty in patients with cerebral palsy. Total hip arthroplasty is a durable treatment option and provides clinically important pain relief and functional improvement in patients with cerebral palsy.

PMID: 28291181

**24. Incidence and risk factors of hardware-related complications after proximal femoral osteotomy in children and adolescents.**

Chung MK, Kwon SS, Cho BC, Lee GW, Kim J, Moon SJ, Lee JW, Chung CY, Sung KH, Lee KM, Park MS.

J Pediatr Orthop B. 2017 Mar 8. doi: 10.1097/BPB.0000000000000448. [Epub ahead of print]

Proximal femoral osteotomy has been used in cerebral palsy, Perthes disease, hip dysplasia, idiopathic femoral anteversion, and various hip diseases in children and adolescents. Conventionally, a blade plate (BP) has been used. However, the pediatric locking compression plate (LCP) has recently been applied widely. We compared the hardware-related complications of the BP and the LCP as well as the factors influencing these complications in patients who have undergone a proximal femoral osteotomy in children and adolescents. We enrolled consecutive patients aged less than or equal to 20 years who had undergone proximal femoral osteotomy with BP or LCP between May 2003 and December 2014, and who were followed up until 6 months after hardware removal. Following consensus building, hardware-related complications were identified from the patients' medical records and hip radiographs. Patient age, sex, type of plate, and Gross Motor Function Classification System (GMFCS) level in cerebral palsy patients were evaluated as possible risk factors, and a generalized estimating equation was used to assess the risk factors for hardware-related complications. A total of 417 hips from 251 patients were finally included in this study. Seven losses of fixation around the plate (five patients, 3.0%) occurred in the BP, three implant-related fractures (three patients, 3.6%) occurred in the LCP, and there was no significant difference (P=0.74). All hardware-related

complications occurred in cerebral palsy patients, and the implant-related fractures occurred in patients with GMFCS IV/V. The risk of complications increased with age (P=0.002). The risk of loss of fixation around the BP is a well-known complication. However, LCP is not without hardware-related complications. The LCP provides strong stability of fixation. However, it is speculated that the LCP is related to implant-related fractures because of the stress shielding effect. Therefore, care should be exercised when using a locking plate in patients with osteoporosis, such as cerebral palsy with GMFCS IV/V.

PMID: 28277416

**25. The Influence of the Unaffected Hip on Gait Kinematics in Patients With Hemiplegic Cerebral Palsy.**

Tretiakov M, Do KP, Aiona M.

J Pediatr Orthop. 2017 Apr/May;37(3):217-221. doi: 10.1097/BPO.0000000000000620.

BACKGROUND: Hemiplegic cerebral palsy (HCP) patients have transverse-plane gait deviations that may include the "uninvolved" side. The aim of this study is to quantify the static rotational profile, the dynamic position during gait and determine whether any correlations between the involved and uninvolved side exist. METHODS: A total of 171 subjects that met the inclusion criteria of HCP and no prior history of bony surgery were reviewed. Clinical and gait measurements were analyzed and compared between subjects and a population of typically developing (TD) children. RESULTS: Among children with HCP, static internal hip rotation of the affected limb was strongly correlated to static internal hip rotation on the unaffected limb (r=0.543, P<0.0001).There were 100 patients with maximum static internal rotation ≥66% of the total arc of motion in the affected hip. These subjects showed significant differences of static range of motion measures of the affected hip compared with TD. They also showed statistical significant differences between the dynamic measures of the affected limb of HCP and TD for mean pelvic rotation, mean hip rotation, and mean knee progression.In these 100 subjects, 23 patients had a maximum static internal rotation ≥66% of the total arc of motion on the unaffected hip and there were 77 subjects with <66% static internal rotation. Pelvic rotation and hip rotation were statistically different between these 2 groups, but knee progression angle was not significant. CONCLUSIONS: The "unaffected" side in patients with HCP influence gait kinematics. If static internal hip rotation exceeds 66% of the total arc of motion, almost all studied static and gait parameters were abnormal in HCP children, regardless if it was the affected side. Compensations on the "unaffected" side seem to be somewhat limited if the anatomic alignment is significantly asymmetric. This may be 1 reason pelvic transverse-plane changes after femoral rotation osteotomy are unpredictable.

PMID: 28278135

**26. Accuracy and Reliability of Marker Based Approaches to Scale the Pelvis, Thigh and Shank Segments in Musculoskeletal Models.**

Kainz H, Hoang H, Stockton C, Boyd RR, Lloyd DG, Carty CP.

J Appl Biomech. 2017 Mar 14:1-21. doi: 10.1123/jab.2016-0282. [Epub ahead of print]

Gait analysis together with musculoskeletal modelling is widely used for research. In the absence of medical images, surface marker locations are used to scale a generic model to the individual's anthropometry. Studies evaluating the accuracy and reliability of different scaling approaches in a paediatric and/or clinical population have not yet been conducted and, therefore, formed the aim of this study. Magnetic resonance images (MRI) and motion capture data were collected from twelve participants with cerebral palsy and six typically developed participants. Accuracy was assessed by comparing the scaled model's segments measures to the corresponding MRI measures, whereas reliability was assessed by comparing the model's segments scaled with the experimental marker locations from the first and second motion capture session. The inclusion of joint centres into the scaling process significantly increased the accuracy of thigh and shank segment length estimates compared to scaling with markers alone. Pelvis scaling approaches which included the pelvis depth measure led to the highest errors compared to the MRI measures. Reliability was similar between scaling approaches with mean ICC of 0.97. Pelvis should be scaled using pelvic width and height and the thigh and shank segment should be scaled using the proximal and distal joint centres.

PMID: 28290736

**27. Effectiveness of surgical and non-surgical management of crouch gait in cerebral palsy: A systematic review.**

Galey SA, Lerner ZF, Bulea TC, Zimbler S, Damiano DL.

Gait Posture. 2017 Feb 24;54:93-105. doi: 10.1016/j.gaitpost.2017.02.024. [Epub ahead of print]

BACKGROUND: Cerebral palsy (CP) is a prevalent group of neuromotor disorders caused by early injury to brain regions or pathways that control movement. Patients with CP exhibit a range of functional motor disabilities and pathologic gait patterns. Crouch gait, characterized by increased knee flexion throughout stance, is a common gait pattern in CP that increases energy costs of walking and contributes to ambulatory decline. Our aim was to perform the first systematic literature review on the effectiveness of interventions utilized to ameliorate crouch gait in CP. METHODS: Comprehensive searches of five medical databases yielded 38 papers with 30 focused on orthopaedic management. RESULTS: Evidence supports the use of initial hamstring lengthenings and rectus femoris transfers, where indicated, for improving objective gait measures with limited data on improving gait speed or gross motor function. In contrast, evidence argues against hamstring transfers and revision hamstring lengthening, with recent interest in more technically demanding corrective procedures. Only eight studies evaluated alternatives to surgery, specifically strength training, botulinum toxin or orthoses, with inconsistent and/or short-lived results. CONCLUSIONS: Although crouch in CP is recognized clinically as a complex multi-joint, multi-planar gait disorder, this review largely failed to identify interventions beyond those which directly address sagittal plane knee motion, indicating a major knowledge gap. Quality of existing data was notably weak, with few studies properly controlled or adequately sized. Outcomes from specific procedures are confounded by multilevel surgeries. Successful longer term strategies to prevent worsening of crouch and subsequent functional decline are needed.

PMID: 28279852

**28. Quantitative assessment of muscle stiffness with acoustic radiation force impulse elastography after botulinum toxin A injection in children with cerebral palsy.**

Ceyhan Bilgici M, Bekci T, Ulus Y, Bilgici A, Tomak L, Selcuk MB.

J Med Ultrason (2001). 2017 Mar 7. doi: 10.1007/s10396-017-0780-y. [Epub ahead of print]

PURPOSE: Our objective in this study was to assess the changes in medial gastrocnemius muscle (GCM) stiffness after botulinum toxin A (BTA) injection in children with cerebral palsy (CP) by using acoustic radiation force impulse (ARFI) elastography and to research the usability of this technique in clinical practice. MATERIALS AND METHODS: Twenty-four spastic lower extremities of 12 children with CP were assessed. BTA injection treatment was applied to the medial GCM. Muscle stiffness was measured with the ARFI technique before the procedure and a month after the procedure. The patients were assessed with the modified Ashworth scale (MAS) in the physiotherapy department at about the same time. Shear wave velocity (SWV) values and MAS scores before and after the treatment were compared. RESULTS: Mean SWV values were measured as 3.20 ± 0.14 m/s before BTA and as 2.45 ± 0.21 m/s after BTA, and the difference between them was found to be statistically significant ($p < 0.001$). Mean MAS score (2.33 ± 0.70) after BTA decreased significantly when compared to the score before BTA (2.96 ± 0.62) ($p = 0.001$). SWV values positively correlated with MAS scores ($\rho = 0.578$, $p = 0.003$). The interobserver agreement expressed as interclass correlation coefficient (ICC) was 0.65 (95% CI 0.33-0.84, $p < 0.001$). CONCLUSION: ARFI elastography for identifying structural changes that occur in the spastic muscle after BTA injection in children with CP can yield more valuable information with combined use of MAS.

PMID: 28271231

**29. The effect of weight bearing on bone mineral density and bone growth in children with cerebral palsy: A randomized controlled preliminary trial.**

Han EY, Choi JH, Kim SH, Im SH.

Medicine (Baltimore). 2017 Mar;96(10):e5896. doi: 10.1097/MD.0000000000005896.

BACKGROUND: The present study aims to explore the effect of weight bearing exercise on bone mineral density (BMD) and bone growth in children with cerebral palsy (CP). METHODS: Twelve children with CP of functional level of gross motor functional classification scale (GMFCS) V and 6 healthy children (control group) were included in the study. Participants underwent a dual-energy X-ray absorptiometry scan to measure the BMD of the femur and full-length anteroposterior radiography to measure the bone length of the femur and tibia at baseline and after 6 months. Patients were randomly divided

into 2 groups: group A with programmed standing exercises and assisted standing for more than 2 hours a day, more than 5 days a week; and group B with conventional physiotherapy with a standing program for 20 minutes a day, 2 to 3 days a week. RESULTS: A 6-month follow-up showed significantly increased BMD on the femur neck in the control group. Although the changes in BMD were not significant in both groups, group A demonstrated an increased trend of BMD, whereas group B showed a decreased trend. Bone length was significantly increased in all 3 groups at the 6-month follow-up. Although this increase was not significant, the change in bone length was greatest in the control group. The smallest changes were observed in group B. CONCLUSIONS: Weight bearing exercise may play an important role in increasing or maintaining BMD in children with CP and is also expected to promote bone growth. Programmed standing may be used as an effective treatment method to increase BMD in children with CP. However, further studies with a larger cohort and longer follow-up period are required to reveal further information on the benefit of weight bearing exercise and to develop a detailed program.

PMID: 28272197

**30. BCL6 mediates the effects of Gastrodin on promoting M2-like macrophage polarization and protecting against oxidative stress-induced apoptosis and cell death in macrophages.**

Jia J, Shi X, Jing X, Li J, Gao J, Liu M, Lin CI, Guo X, Hua Q.

Biochem Biophys Res Commun. 2017 Mar 16. pii: S0006-291X(17)30519-3. doi: 10.1016/j.bbrc.2017.03.062. [Epub ahead of print]

Cerebral palsy (CP) is the most common childhood disability worldwide, yet biomarkers for predicting CP are lacking. By subjecting peripheral blood samples from 62 CP patients and 30 healthy controls to Affymetrix GeneChip® PrimeView™ HumanGene Expression Microarray analysis, we identified the novel biomarker B-cell lymphoma 6 (BCL6) as the most upregulated gene in the CP samples. Gastrodin is a traditional Chinese medicine and bioactive compound that promotes adductor angle release, as well as gross and fine motor performance by increasing Gross Motor Function Measure-66 and Fine Motor Function Measure-45 scores. Gastrodin upregulates the mRNA expression of Mgl2 and Mrc1, M2 macrophage markers, and arginase activity, an M2 polarization indicator, in murine RAW264.7 macrophages. Moreover, these effects were blocked by BCL6 siRNA, which also abrogated the protective effects of Gastrodin against hydrogen peroxide-induced apoptosis and death in RAW264.7 cells. Our work identified BCL6 as a novel biomarker for early prediction of CP. Moreover, we demonstrated that Gastrodin not only stimulated polarization toward M2-like macrophages, which promote tissue repair, but also rescued macrophages from oxidative stress, apoptosis and death by inducing BCL6 expression. BCL6-targeted therapeutic strategies have promise for improving motor performance in CP patients.

PMID: 28315684

**31. Speech production gains following constraint-induced movement therapy in children with hemiparesis.**

Allison KM, Reidy TG, Boyle M, Naber E, Carney J, Pidcock FS.

J Pediatr Rehabil Med. 2017;10(1):3-9. doi: 10.3233/PRM-170405.

PURPOSE: The purpose of this study was to investigate changes in speech skills of children who have hemiparesis and speech impairment after participation in a constraint-induced movement therapy (CIMT) program. While case studies have reported collateral speech gains following CIMT, the effect of CIMT on speech production has not previously been directly investigated to the knowledge of these investigators. METHODS: Eighteen children with hemiparesis and co-occurring speech impairment participated in a 21-day clinical CIMT program. The Goldman-Fristoe Test of Articulation-2 (GFTA-2) was used to assess children's articulation of speech sounds before and after the intervention. Changes in percent of consonants correct (PCC) on the GFTA-2 were used as a measure of change in speech production. RESULTS: Children made significant gains in PCC following CIMT. Gains were similar in children with left and right-sided hemiparesis, and across age groups. CONCLUSION: This study reports significant collateral gains in speech production following CIMT and suggests benefits of CIMT may also spread to speech motor domains.

PMID: 28339405

**32. Methods for conceptualising 'visual ability' as a measurable construct in children with cerebral palsy.**

Deramore Denver B, Adolfsson M, Froude E, Rosenbaum P, Imms C.

BMC Med Res Methodol. 2017 Mar 21;17(1):46. doi: 10.1186/s12874-017-0316-6.

BACKGROUND: Vision influences functioning and disability of children with cerebral palsy, so there is a growing need for psychometrically robust tools to advance assessment of children's vision abilities in clinical practice and research. Vision is a complex construct, and in the absence of clarity about this construct it is challenging to know whether valid, reliable measures exist. This study reports a method for conceptualising 'visual ability' as a measurable construct. METHODS: Using the items from 19 assessment tools previously identified in a systematic review, this study used a two-phase process: first, deductive content analysis linked items to the International Classification of Functioning, Disability and Health - Child and Youth version (ICF-CY), and second, vision-specific 'Activity'-level items were explored using inductive thematic analysis. RESULTS: The linking and content analysis identified that existing assessment tools are measuring vision across the ICF-CY domains of Body Functions, Activities and Participation, and Environmental and Personal Factors. Items specifically coded to vision at the Activity level were defined as measuring 'how vision is used', and these items form the basis of the conceptualisation that 'visual ability' is measurable as a single construct. The thematic analysis led to the identification of 3 categories containing 13 themes that reflect a child's observable visual behaviours. Seven abilities reflect how a child uses vision: responds or reacts, initiates, maintains or sustains looking, changes or shifts looking, searches, locates or finds, and follows. Four interactions reflect the contexts in which a child uses their vision to purposefully interact: watches and visually interacts with people and faces, objects, over distance, and with hands. Finally, two themes reflect a child's overall use of vision in daily activities: frequency of use, and efficiency of use. CONCLUSIONS: This study demonstrates an approach to exploring and explaining a complex topic utilising World Health Organization language and building on existing research. Despite the complexity of vision, the concept of 'how vision is used' can be clearly defined as a measurable construct at the Activity level of the ICF-CY. This study has identified observable visual behaviours that may be developed into items assessing how vision is used in daily activities.

PMID: 28320348

**33. Setting up of a cerebral visual impairment clinic for children: Challenges and future developments.**

Philip SS.

Indian J Ophthalmol. 2017 Jan;65(1):30-34. doi: 10.4103/0301-4738.202303.

AIM: The aim of this study is to describe the setting up of a cerebral visual impairment (CVI) clinic in a tertiary care hospital in South India and to describe the spectrum of cases seen. MATERIALS AND METHODS: The CVI clinic, set up in February 2011, receives interdisciplinary input from a core team involving a pediatrician, neurologist, psychiatrist, occupational therapist, pediatric ophthalmologist, and an optometrist. All children, <18 years of age, with cerebral palsy (CP), learning disability, autism, neurodegenerative diseases, and brain trauma are referred to the clinic for functional vision assessment and opinion for further management. RESULTS: One thousand four hundred and seventy-eight patients were seen in the CVI clinic from February 2011 to September 2015. Eighty-five percent of the patients were from different parts of India. In the clinic, 61% had CP, 28% had seizure disorders, autism was seen in 9.5%, and learning disability, neurodegenerative conditions, and brain injury together constituted 1.5%. Most of the children (45%) had moderate CP. Forty percent of CVI was due to birth asphyxia, but about 20% did not have any known cause for CVI. Seventy percent of patients, who came back for follow-up, were carrying out the habilitation strategies suggested. CONCLUSIONS: Average attendance of over 300 new patients a year suggests a definite need for CVI clinics in the country. These children need specialized care to handle their complex needs. Although difficult to coordinate, an interdisciplinary team including the support groups and voluntary organizations is needed to facilitate the successful implementation of such specialized service.

PMID: 28300737

**34. Nutritional assessment and intervention in children with cerebral palsy: a practical approach.**

Scarpato E, Staiano A, Molteni M, Terrone G, Mazzocchi A, Agostoni C.

Int J Food Sci Nutr. 2017 Feb 16:1-8. doi: 10.1080/09637486.2017.1289502. [Epub ahead of print]

Cerebral palsy (CP) is associated with the presence of feeding disorders in almost 60% of the affected children with subsequent undernutrition reported in up to 46% of the subjects. Since undernutrition may have a detrimental impact on physical and cognitive development, the introduction of an adequate nutritional support should always be considered in children with neurological impairment. The aim of the present review is to provide a practical guide to the assessment of nutritional status in children with CP, in order to identify individuals at risk for malnutrition that need the introduction of an adequate and personalized nutritional support. This review summarizes the methods for the evaluation of oral-motor function, anthropometric parameters, body composition and energy balance in children with CP. Moreover, we reviewed the indications for the introduction of nutritional support, and the suggested modalities of intervention.

PMID: 28276905

**35. The Eating and Drinking Ability Classification System in a population-based sample of preschool children with cerebral palsy.**

Benfer KA, Weir KA, Bell KL, Ware RS, Davies PS, Boyd RN.

Dev Med Child Neurol. 2017 Mar 9. doi: 10.1111/dmcn.13403. [Epub ahead of print]

AIM: To determine (1) the reproducibility of the Eating and Drinking Ability Classification System (EDACS); (2) EDACS classification distribution in a population-based cohort with cerebral palsy (CP); and (3) the relationships between the EDACS and clinical mealtime assessment, other classifications, and health outcomes. METHOD: This was a cross-sectional population-based cohort study of 170 children with CP at 3 years to 5 years (mean 57.6mo, standard deviation [SD] 8.3mo; 105 males, n=65 females). Functional abilities were representative of a population sample (Gross Motor Function Classification System level I=74, II=34, III=21, IV=18, V=23). The EDACS was the primary classification of mealtime function. The Dysphagia Disorders Survey was the clinical mealtime assessment. Gross motor function was classified using the Gross Motor Function Classification System. RESULTS: EDACS classification had 88.3% intrarater agreement ($\kappa$=0.84, intraclass correlation coefficient=0.95; $p<0.001$) and 51.7% interrater agreement ($\kappa$=0.36, intraclass correlation coefficient=0.79; $p<0.001$). In total, 56.5% of children were classified as EDACS level I. There was a strong stepwise relationship between the Dysphagia Disorders Survey and EDACS ($r$=0.96, $p<0.001$). Parental stress (odds ratio=1.3, $p$=0.05) and feeding tubes (odds ratio=6.4, $p<0.001$) were significantly related to more limited function on the EDACS. INTERPRETATION: The EDACS presents a viable adjunct to clinical assessment of feeding skills in children with CP for use in surveillance trials and clinical practice. A rating addendum would be a useful contribution to the tool to enhance reproducibility.

PMID: 28276586

**36. Cerebral palsy and sleep disordered breathing.**

Morley A.

Breathe (Sheff). 2016 Dec;12(4):357-363. doi: 10.1183/20734735.012016.

Despite the known correlation between neurodisability and sleep disordered breathing, cases are still missed

PMID: 28270864

**37. Family-centred service: differences in what parents of children with cerebral palsy rate important.**

Terwiel M, Alsem MW, Siebes RC, Bieleman K, Verhoef M, Ketelaar M.

Child Care Health Dev. 2017 Mar 22. doi: 10.1111/cch.12460. [Epub ahead of print]

BACKGROUND: A family-centred approach to services of children with disabilities is widely accepted as the foundational approach to service delivery in paediatric health care. The 56 items of the Measure of Processes of Care questionnaire (MPOC-56) all reflect elements of family-centred service. In this study, we investigated which elements of family-centred service are rated important by parents of children with cerebral palsy by adding a question on importance to each item of the MPOC-56 (MPOC-56-I). METHODS: In total, 175 parents of children with cerebral palsy completed the MPOC-56-I. For each MPOC item, parents were asked to rate the importance on a 5-point scale ranging from 0 (not important at all) up to and including 4 (very important). We used Spearman's rank correlation coefficient to further explore the variation in parents' importance ratings. RESULTS: Parents' importance ratings of the MPOC-56 items varied. The percentage of parents rating an item important (importance rating 3 or 4) varied between 43.8% and 96.8%. The percentage of parents rating an item unimportant (rating 0 or 1) varied between 0.0% and 20.3%, and the percentage of parents rating an item neutral (rating 2) varied between 3.0% and 36.0%. Most diverse importance ratings were found for five items concerning the provision of general information. Three correlations between these items and child and parent characteristics were found. Six items were rated important by almost all (≥95%) parents. These items concern elements of specific information about the child, co-ordinated and comprehensive care for child and family and enabling and partnership. CONCLUSIONS: Parents rate the importance of family-centred services for their situation in various ways. These findings endorse that family-centred services should recognize the uniqueness of families and should be tailored to what parents find important.

PMID: 28326571

**38. Family-centred care for children and young people with cerebral palsy: results from an Italian multicenter observational study.**

Molinaro A, Fedrizzi E, Calza S, Pagliano E, Jessica G, Fazzi E; GIPCI Study Group.

Child Care Health Dev. 2017 Mar 9. doi: 10.1111/cch.12449. [Epub ahead of print]

BACKGROUND: Family-centred care (FCC) is recognized as the model of best practice for the provision of services for children who have physical disabilities and their families. OBJECTIVE: To assess the overall perception of FCC provided in an Italian network of 17 rehabilitation services, as perceived by parents of children with cerebral palsy and professionals, and to explore whether children, families, service providers and service-related characteristics influence parent satisfaction regarding service provision in an FCC practice. METHODS: The Measure of Processes of Care (MPOC-20) for parents/caregivers and the Measure of Processes of Care for Service Providers (MPOC-SP) for healthcare providers were used. For the purposes of the study, an ad hoc information form was developed to collect information concerning children, families, service providers and services. RESULTS: A total of 382 parents/caregivers and 269 healthcare providers completed the MPOC questionnaires. Parents and service providers both identified the domains for enabling partnerships and interpersonal sensitivity as a strength, while the domain relating to general information was always scored the lowest. An advanced maternal age, being a single parent, being unemployed and having lower socio-economic status were factors identified as individually predictive of lower FCC scores on the MPOC-20. Higher intensity treatment, inpatient services, primary healthcare settings and settings identified with limited financial resources and reduced space/time for each family were other variables significantly associated with less favourable MPOC-20 ratings. CONCLUSIONS: The perception of FCC provided was fairly positive, with some areas of improvement, such as the domain of provision of information. Professionals should, therefore, provide better communication and take more time in giving information and attention to parents. Potential sources of variation in parent perceptions of FCC based on family characteristics and the organization of services highlight the importance the need to support services through the provision of greater financial and human resources.

PMID: 28281289

**39. Health-related quality of life in children and adolescents with cerebral palsy.**

Radsel A, Osredkar D, Neubauer D.

Zdr Varst. 2016 Jul 28;56(1):1-10. doi: 10.1515/sjph-2017-0001. eCollection 2017.

INTRODUCTION: In a cross-sectional cohort study, health-related quality of life of Slovenian children and adolescents with cerebral palsy was examined, and factors associated with it have been identified. METHODS: Caregivers of 122 children and adolescents with cerebral palsy were addressed to fill out proxy versions of HRQoL questionnaires (DISABKIDS generic and cerebral palsy module). Children and adolescents without cognitive deficit were asked to fill out the self-report versions. RESULTS: Ninety-one families of 43 children (the mean age is 10 years, 6 months, SD 1.2; 26 males and 17 females) and 48 adolescents (the mean age is 14 years, SD 0.9; 23 males and 25 females) completed proxyreports. Forty-eight individuals were able to self-report (26 children and 22 adolescents). Health-related quality of life was perceived as good. Self-reporting participants scored higher than their caregivers (mean score 75.6, SD 15.9 versus mean 72.3, SD 17.9; p=0.048). Adolescents scored lower than children in all domains (mean score 69.4, SD 19.4 versus mean 80.8, SD 10.0; p=0.01). Higher age (p<0.001), pain (p<0.001) and disturbed sleep (p=0.002) were strong predictors of worse health-related quality of life. Social Inclusion and Independence domains received the lowest scores. CONCLUSIONS: Slovenian children and adolescents with cerebral palsy have a good health-related quality of life, with Social Inclusion and Independence being the weakest domains. Children reported higher scores than adolescents or their caretakers. Pain was the strongest predictor of poor health-related quality of life.

PMID: 28289457

**40. Participation of Iranian Cerebral Palsy Children in Life Areas: A Systematic Review Article.**

Pashmdarfard M, Amini M, Hassani Mehraban A.

Iran J Child Neurol. 2017 Winter;11(1):1-12.

OBJECTIVE: Cerebral palsy (CP) is the most common cause of chronic disability that restricts participation in areas of occupations for children. The main aim of rehabilitation is enhancement of their clients for participation in occupations. The aim of this study was to overview of the factors influencing the participations of children with CP in Iran. MATERIALS & METHODS: A systematic, evidence-based process (Duffy 2005) was used. For data gathering electronic databases including Google scholar and Iranian and foreigner famous journals in the fields of pediatrics, were used. The main key words for search were Activity of Daily Living (ADL), Instrumental Activity of Daily Living (IADL), play, leisure, work, rest/sleep, social participation, and education. All the papers of this study were about the factors influencing the participation of Iranian CP children during 2000-2016. Totally, 156 articles were found eligible as for Iranian CP children study, of which 100 articles were discarded. Because of repetitive and duplicability of some articles, 17 articles were removed as well. RESULTS: The most studies about Iranian CP children participations in life areas were in the ADL area of participation (N=12), and the lowest articles were in the area in the field of: Work (N=2), play (N=2), and sleep/rest (N=2). Most of the occupational therapists do not focus on the all life areas. CONCLUSION: In Iran, many researchers do not pay attention to the participation of CP children. Many articles just paid attention to the sensory, motor or cognitive components of their clients.

PMID: 28277550

**41. Course of employment in adults with cerebral palsy over a 14-year period.**

Benner JL, Hilberink SR, Veenis T, van der Slot WM, Roebroeck ME.

Dev Med Child Neurol. 2017 Mar 17. doi: 10.1111/dmcn.13423. [Epub ahead of print]

AIM: To explore the course of employment in adults with cerebral palsy (CP) over 14 years, and to identify subgroups at risk for unemployment. METHOD: Sixty-five adults with CP (33 males, 32 females; baseline age 25y 8mo, standard deviation [SD] 3y 2mo; intellectual impairment 25%; bilateral CP 65%) participated in a prospective cohort study. Self-reports of employment and work hours per week in 1996, 2000, and 2010 were documented. The course of employment (including sheltered work) and work hours per week were analysed, using generalized estimating equations (GEE). RESULTS: Overall, employment rate was stable over time (38-45%, p=0.413), but lower than in the general population (75-86%, p<0.001). Employment rates were

specifically low in adults with intellectual impairment, bilateral CP, and in adults with Gross Motor Function Classification System (GMFCS) levels IV and V. Work hours per week declined (35.0 [SD 7.9] to 31.2 [SD 10.3], p=0.033), especially among females (32.3 [SD 6.4] to 23.4 [SD 7.4], p<0.001). Similar to the general population, females often worked part-time. INTERPRETATION: Employment was low compared with the general population, but remained stable in the long term; however, work hours per week decreased. Adults with intellectual impairment, bilateral CP, and GMFCS levels IV and V are subgroups at risk for unemployment.

PMID: 28304081

**42. Cerebral palsy: a multidisciplinary, integrated approach is essential.**

Bulekbayeva S, Daribayev Z, Ospanova S, Vento S.

Lancet Glob Health. 2017 Apr;5(4):e401. doi: 10.1016/S2214-109X(17)30082-7.

Cerebral palsy, a syndrome of motor impairment resulting from a lesion in the developing brain, has a worldwide prevalence of 1·0–3·5 per 1000 livebirths.1,2 A life-course perspective needs to be adopted as more children live into their adolescence and adulthood. Individuals' participation in life and availability of family-centred services are very important and differ between countries.3 In low-income countries, most treatments are provided by families and multidisciplinary assessment is done in rural clinics.

PMID: 28288745

**43. Complementary traditional Chinese medicine use in Children with cerebral palsy: a nationwide retrospective cohort study in Taiwan.**

Liao HH, Yen HR, Muo CH, Lee YC, Wu MY, Chou LW, Sun MF, Chang TT.

BMC Complement Altern Med. 2017 Mar 14;17(1):155. doi: 10.1186/s12906-017-1668-5.

BACKGROUND: Complementary traditional Chinese medicine (TCM) has been used to treat patients with cerebral palsy (CP). However, large-scale surveys examining its use in the treatment of CP and associated disorders are lacking. METHODS: We enrolled 11,218 patients ≤ 18 years of age with CP in the Taiwanese National Health Insurance Research Database from 1995 to 2011. Patients were categorized as TCM users (n = 6,997; 62.37%) and non-TCM users (n = 4,221; 37.63%) based on the inclusion of TCM in their treatment plan. RESULTS: Children with higher proportions of complementary TCM use were male, younger, and lived in urbanized areas. Most TCM users (n = 5332, 76.2%) visited TCM outpatient departments more than 20 times per year. In both groups, the three most common reasons for clinical visits were problems of the nervous system, respiratory system, and digestive system. Acupuncture was commonly used in problems of injury, musculoskeletal system and connective tissue, and nervous system. Chinese herbal medicine was used to improve the primary symptoms of CP in patients, as well as its associated disorders. The incidence rate ratios in allergic rhinitis, dyspepsia, menstrual disorders, and musculoskeletal system and connective tissue diseases among TCM users were significantly higher than non-TCM users. Although patients receiving complementary TCM therapies had higher medical expenditure for utilizing outpatient clinical consultations, their medical costs for visiting ER and hospitalization were significantly lower than that of non-TCM user within one year of the diagnosis of CP. CONCLUSION: This study was a large-scale survey to characterize patterns of complementary TCM use among children with CP. The complementary use of TCM in children with CP was considerably high. Future clinical trials and basic researches can be developed based on the findings of this study.

PMID: 28288600

**44. Symptom Recognition and Diagnosis of Cerebral Palsy in Nepal.**

Thapa R.

J Autism Dev Disord. 2017 Mar 15. doi: 10.1007/s10803-017-3090-8. [Epub ahead of print]

Cerebral palsy (CP) is the most common movement disorder of childhood. Parents recognized the symptoms of CP at mean age of 13 months. However there was a mean delay of going to a doctor by 23 months and the mean age of diagnosis was 5½ years. Less than half of the CP children were diagnosed by a pediatrician and were receiving treatment methods with weak evidence base of efficacy. Delay in recognition of symptoms and help seeking due to lack of awareness and access to proper medical care and prevalent false beliefs were the leading reason for late diagnosis of CP in Nepal and thus children loose valuable time for intervention in their early developmental stage.

PMID: 28299509

**45. Clinical Spectrum of Cerebral Palsy and Associated Disability in South Egypt: A Local Survey Study.**

Abas O, Abdelaziem F, Kilany A.

Open Access Maced J Med Sci. 2017 Mar 15;5(1):37-41. doi: 10.3889/oamjms.2017.020. Epub 2017 Feb 4.

BACKGROUND: Cerebral palsy is the most common cause of motor disability in children with a prevalence of 2-10/1,000 live births in the developing areas. AIM: The epidemiology, clinical picture, and associated comorbidities in CP have been extensively studied in high-resource countries, but in low-resource areas, including Africa, those studies are still lacking. METHODS: Cerebral palsy cases were prospectively recruited from every physiotherapy centre in Bani-Mazar city, Egypt, in a cross-sectional study from May 2015 to November 2015. RESULTS: Two hundred cases were enrolled with a prevalence of 1 per 1000 live births. Within the study population, 72.5% were the spastic type, 16% were dyskinetic, 7% were ataxic, and 4.5% were hypotonic. The most common comorbidities were cognitive impairment and epilepsy affecting 77% and 38%, respectively. CONCLUSION: Cerebral palsy in developing countries has a higher prevalence and different clinical profile regarding severity and associated disability. The perinatal and high-quality neonatal care together with physical therapy and rehabilitation programs is still lacking in developing countries.

PMID: 28293314

**46. Functional outcomes in children and young people with dyskinetic cerebral palsy.**

Monbaliu E, De La Peña MG, Ortibus E, Molenaers G, Deklerck J, Feys H.

Dev Med Child Neurol. 2017 Mar 8. doi: 10.1111/dmcn.13406. [Epub ahead of print]

AIM: This cross-sectional study aimed to map the functional profile of individuals with dyskinetic cerebral palsy (CP), to determine interrelationships between the functional classification systems, and to investigate the relationship of functional abilities with dystonia and choreoathetosis severity. METHODS: Fifty-five children (<15y) and young people (15-22y) (30 males, 25 females; mean age 14y 6mo, standard deviation 4y 1mo) with dyskinetic CP were assessed using the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), Communication Function Classification System (CFCS), Eating and Drinking Ability Classification System (EDACS), and Viking Speech Scale (VSS), as well as the Dyskinesia Impairment Scale. RESULTS: Over 50 per cent of the participants exhibited the highest limitation levels in GMFCS, MACS, and VSS. Better functional abilities were seen in EDACS and CFCS. Moderate to excellent interrelationship was found among the classification scales. All scales had significant correlation (rs =0.65 - 0.81) with dystonia severity except for CFCS in the young people group. Finally, only MACS (rs =0.40) and EDACS (rs =0.55) in the young people group demonstrated significant correlation with choreoathetosis severity. INTERPRETATION: The need for inclusion of speech, eating, and drinking in the functional assessment of dyskinetic CP is highlighted. The study further supports the strategy of managing dystonia in particular at a younger age followed by choreoathetosis in a later stage.

PMID: 28272743

**47. Towards a comprehensive profile of dyskinetic cerebral palsy.**

Pueyo R.

Dev Med Child Neurol. 2017 Mar 13. doi: 10.1111/dmcn.13421. [Epub ahead of print]

[This commentary is on the original article by Monbaliu et al.]

PMID: 28295237

# Prevention and Cure

**48. Accuracy and Reliability of Stroke Diagnosis in the Pediatric Emergency Department.**

Mackay MT, Yock-Corrales A, Churilov L, Monagle P, Donnan GA, Babl FE.

Stroke. 2017 Mar 23. pii: STROKEAHA.116.015571. doi: 10.1161/STROKEAHA.116.015571. [Epub ahead of print]

BACKGROUND AND PURPOSE: Access to acute stroke interventions in the emergency department (ED) relies on correct clinical diagnosis. Our aims were to determine the accuracy and reliability of pediatric ED physician diagnosis of childhood stroke and other conditions presenting with brain attack symptoms. METHODS: Prospective study of consecutive children aged 1 month to 18 years presenting to the ED from June 2009 to December 2010 with focal neurological deficits. Accuracy (sensitivity, specificity, and receiver operator characteristic curves [ROCs]) and interrater agreement (κ) were determined, between ED physician diagnoses, as recorded in the electronic hospital administrative software system, and final neurological diagnosis, after completion of diagnostic work-up. RESULTS: Two-hundred eighty-seven children with 301 consecutive presentations were recruited. The most common final brain attack diagnoses included migraine in 84 children, first seizure in 48, Bell's palsy in 29, stroke in 21, and conversion disorders in 18 children. Sensitivity of ED physician stroke diagnosis was 62%, and specificity was 98% (ROC, 0.8). Inter-rater agreement for ED physician and final stroke diagnosis was substantial (κ=0.61). ED physician diagnostic accuracy and reliability was highest for Bell's palsy (ROC=0.98; κ=0.96), and lowest for central nervous system demyelination (ROC=0.5; κ=-0.01) and cerebellitis (ROC=0.50; κ=0.50). CONCLUSIONS: ED physician diagnostic accuracy and reliability varies considerably across disorders presenting with brain attack symptoms. Clinical recognition tools are required to assist pediatric ED physicians with diagnosis of stroke and other serious neurological disorders.

PMID: 28336681

**49. Maternal, Labor, Delivery, and Perinatal Outcomes Associated with Placental Abruption: A Systematic Review.**

Downes KL, Grantz KL, Shenassa ED.

Am J Perinatol. 2017 Mar 22. doi: 10.1055/s-0037-1599149. [Epub ahead of print]

Objective  Risk factors for placental abruption have changed, but there has not been an updated systematic review investigating outcomes. Methods  We searched PubMed, EMBASE, Web of Science, SCOPUS, and CINAHL for publications from January 1, 2005 through December 31, 2016. We reviewed English-language publications reporting estimated incidence and/or risk factors for maternal, labor, delivery, and perinatal outcomes associated with abruption. We excluded case studies, conference abstracts, and studies that lacked a referent/comparison group or did not clearly characterize placental abruption. Results  A total of 123 studies were included. Abruption was associated with elevated risk of cesarean delivery, postpartum hemorrhage and transfusion, preterm birth, intrauterine growth restriction or low birth weight, perinatal mortality, and cerebral palsy. Additional maternal outcomes included relaparotomy, hysterectomy, sepsis, amniotic fluid embolism, venous thromboembolism, acute kidney injury, and maternal intensive care unit admission. Additional perinatal outcomes included acidosis, encephalopathy, severe respiratory disorders, necrotizing enterocolitis, acute kidney injury, need for resuscitation, chronic lung disease, infant death, and epilepsy. Conclusion  Few studies examined outcomes beyond the initial birth period, but there is evidence that both mother and child are at risk of additional adverse outcomes. There was also considerable variation in, or absence of, the reporting of abruption definitions.

PMID: 28329897

**50. Lessons Learned at the Epicenter of Brazil's Congenital Zika Epidemic: Evidence from 87 Confirmed Cases.**

Meneses JD, Ishigami AC, de Mello LM, Albuquerque LL, Brito CA, Tenório Cordeiro M, Pena LJ.

Clin Infect Dis. 2017 Feb 24. doi: 10.1093/cid/cix166. [Epub ahead of print]

Congenital Zika virus infection has stimulated great international concern. A prospective case series of 87 infants with laboratory-confirmed congenital Zika syndrome (CZS) at the epicenter of the Brazilian Zika epidemic in Pernambuco state is presented. Mothers were interviewed for symptoms of possible Zika virus (ZIKV) infection during pregnancy and fetal ultrasounds were obtained. Infant cerebrospinal fluid (CSF) samples were tested for ZIKV specific antibodies and sera were screened for other congenital infections. Neuroimaging and ophthalmologic evaluations were also performed. Sixty six mothers (76%) reported symptoms of ZIKV infection during gestation. Fetal ultrasounds were available from 90% of the mothers and all demonstrated brain structural abnormalities. All the CSF samples tested positive for ZIKV IgM. The majority of infants (89%) were term, the mean birth weight was 2577±260g and the mean head circumference was 28.1±1.8 cm. Severe microcephaly, defined as head circumference below 3 SD for sex and gestational age, was found in 72 (82%) infants. All infants had an abnormal neurological exam and 18 (20.7%) had arthrogryposis. The main abnormalities detected in CT scans were calcifications (99%), followed by ventricular enlargement (94%), cortical hypogyration (81%), and less commonly, cerebellar hypoplasia (52%). Unilateral diaphragm paralysis was identified in three infants. Maternal young age, term infant, small for gestational age and the presence of ophthalmologic abnormalities were significantly associated with a smaller head circumference Z score. Our findings, based on laboratory-confirmed ZIKV infection, add valuable evidence for the understanding of CZS.

PMID: 28329257

**51. Could Perinatal Asphyxia Induce a Synaptopathy? New Highlights from an Experimental Model.**

Herrera MI, Otero-Losada M, Udovin LD, Kusnier C, Kölliker-Frers R, de Souza W, Capani F.

Neural Plast. 2017;2017:3436943. doi: 10.1155/2017/3436943. Epub 2017 Feb 23.

Birth asphyxia also termed perinatal asphyxia is an obstetric complication that strongly affects brain structure and function. Central nervous system is highly susceptible to oxidative damage caused by perinatal asphyxia while activation and maturity of the proper pathways are relevant to avoiding abnormal neural development. Perinatal asphyxia is associated with high morbimortality in term and preterm neonates. Although several studies have demonstrated a variety of biochemical and molecular pathways involved in perinatal asphyxia physiopathology, little is known about the synaptic alterations induced by perinatal asphyxia. Nearly 25% of the newborns who survive perinatal asphyxia develop neurological disorders such as cerebral palsy and certain neurodevelopmental and learning disabilities where synaptic connectivity disturbances may be involved. Accordingly, here we review and discuss the association of possible synaptic dysfunction with perinatal asphyxia on the basis of updated evidence from an experimental model.

PMID: 28326198

**52. Prevalence Estimate of Cerebral Palsy in Northern Alberta: Births, 2008-2010.**

Robertson CM, Ricci MF, O'Grady K, Oskoui M, Goez H, Yager JY, Andersen JC.

Can J Neurol Sci. 2017 Mar 21:1-9. doi: 10.1017/cjn.2017.33. [Epub ahead of print]

OBJECTIVES: The objectives of this study were to determine prevalence estimates of cerebral palsy (CP) among 5-year-old children in northern Alberta; to provide congenital, gestational age- and birth weight-specific, and postneonatal CP rates; and to describe motor subtypes and function. METHODS: This population-based prevalence estimate study, part of the Canadian Cerebral Palsy Registry, reports confirmed CP diagnoses at age 5 years made by pediatric rehabilitation and child neurology specialists. Prevalence rates with 95% confidence intervals (CIs) used Alberta government denominators of same-age children and live births. RESULTS: The Northern Alberta CP rate (birth years, 2008-2010) for 173 5-year-old children is 2.22 (95% CI 2.12, 2.32) per 1000 5-year-old children. The congenital CP rate is 1.99 (95% CI, 1.89-2.09) per 1000 live births; unilateral congenital CP, 1.0 (95% CI, 0.64-1.36) per 1000 live births; and postneonatal CP, 0.12 (95% CI, 0.1-0.14) per 1000 live births.

Gestational age-specific rates are similar: age <28 weeks, 27.2 (95% CI, 23.05-31.35) and 28 to 31 weeks, 29.5 (95% CI, 25.78 -33.22). Motor subtypes for 169 children (data missing, 4; male, 97; postnatal, 9) are: spastic, 148 (87.6%) including 31 (20.9%) with diplegia, 10 (6.8%) triplegia, 33 (22.2%) quadriplegia, 74 (50%) hemiplegia/monoplegia); and dyskinetic, 18 (10.6%) and ataxic, 3 (1.8%). A total of 107 (63.3%) ambulate without assistive devices and 111(65.7%) handle most objects with their hands independently. CONCLUSIONS: This is the fourth Canadian CP prevalence study; one from Quebec used a similar case ascertainment approach and two 1980s studies from Alberta and British Columbia used administrative databases. Northern Alberta CP rates are comparable with other developed countries. The hemiplegic subtype is the most common. Rates among preterm children have declined but are similar for the <28 and 28 to 31 gestation-week groups.

PMID: 28322177

**53. Preterm Labor: Prevention and Management.**

Rundell K, Panchal B.

Am Fam Physician. 2017 Mar 15;95(6):366-372.

In the United States, preterm delivery is the leading cause of neonatal morbidity and is the most common reason for hospitalization during pregnancy. The rate of preterm delivery (before 37 weeks' gestation) has been declining since 2007. Clinical diagnosis of preterm labor is made if there are regular contractions and concomitant cervical change. Less than 10% of women with a clinical diagnosis of preterm labor will deliver within seven days of initial presentation. Women with a history of spontaneous preterm delivery are 1.5 to two times more likely to have a subsequent preterm delivery. Antenatal progesterone is associated with a significant decrease in subsequent preterm delivery in certain pregnant women. Current recommendations are to prescribe vaginal progesterone in women with a shortened cervix and no history of preterm delivery, and to use progesterone supplementation regardless of cervical length in women with a history of spontaneous preterm delivery. Cervical cerclage has been used to help correct structural defects or cervical weakening in high-risk women with a shortened cervix. A course of corticosteroids is the only antenatal intervention that has been shown to improve postdelivery neonatal outcomes, including a reduction in neonatal mortality, intracranial hemorrhage, necrotizing enterocolitis, and neonatal infection. Tocolytics, especially prostaglandin inhibitors and calcium channel blockers, may allow time for the administration of antenatal corticosteroids and transfer to a tertiary care facility if necessary. When used in specific at-risk populations, magnesium sulfate provides neuroprotection and decreases the incidence of cerebral palsy in preterm infants.

PMID: 28318214

**54. Children born at 32 to 35 weeks with birth asphyxia and later cerebral palsy are different from those born after 35 weeks.**

Garfinkle J, Wintermark P, Shevell MI, Oskoui M; Canadian Cerebral Palsy Registry.

J Perinatol. 2017 Mar 16. doi: 10.1038/jp.2017.23. [Epub ahead of print]

OBJECTIVE: The objectives of this study were to (1) establish the proportion of cerebral palsy (CP) that occurs with a history suggestive of birth asphyxia in children born at 32 to 35 weeks and (2) evaluate their characteristics in comparison with children with CP born at ⩾36 weeks with such a history. STUDY DESIGN: Using the Canadian CP Registry, children born at 32 to 35 weeks of gestation with CP with a history suggestive of birth asphyxia were compared with corresponding ⩾36 weeks of gestation children. RESULTS: Of the 163 children with CP born at 32 to 35 weeks and 738 born at ⩾36 weeks, 26 (16%) and 105 (14%) had a history suggestive of birth asphyxia, respectively. The children born at 32 to 35 weeks had more frequent abruptio placenta (35% vs 12%; odds ratio (OR) 4.1, 95% confidence interval (CI) 1.5 to 11.2), less frequent neonatal seizures (35% vs 72%; OR 0.20, 95% CI 0.08 to 0.52), more frequent white matter injury (47% vs 17%; OR 4.3, 95% CI 1.3 to 14.0), more frequent intraventricular hemorrhage (IVH) (40% vs 6%; OR 11.2, 95% CI 3.4 to 37.4) and more frequent spastic diplegia (24% vs 8%; OR 1.8, 95% CI 1.2 to 12.2) than the corresponding ⩾36 weeks of gestation children. CONCLUSIONS: Approximately 1 in 7 children with CP born at 32 to 35 weeks had a history suggestive of birth asphyxia. They had different magnetic resonance imaging patterns of injury from those born at ⩾36 weeks and a higher frequency of IVH. Importantly, when considering hypothermia in preterm neonates with suspected birth asphyxia, prospective surveillance for IVH will be essential.Journal of Perinatology advance online publication, 16 March 2017; doi:10.1038/jp.2017.23.

PMID: 28300820

**55. Antecedents and neuroimaging patterns in cerebral palsy with epilepsy and cognitive impairment: a population-based study in children born at term.**

Ahlin K, Jacobsson B, Nilsson S, Himmelmann K.

Acta Obstet Gynecol Scand. 2017 Mar 12. doi: 10.1111/aogs.13128. [Epub ahead of print]

INTRODUCTION: Antecedents of accompanying impairments in cerebral palsy (CP) and their relation to neuroimaging patterns need to be explored. MATERIAL AND METHODS: A population-based study of 309 children with CP born at term in 1983-1994. Pre-, intra- and postpartum variables previously studied as antecedents of CP type and motor severity were analysed in children with CP and cognitive impairment and/or epilepsy, and in children with CP without these accompanying impairments. Neuroimaging patterns and their relation to identified antecedents were analysed. Data were retrieved from the CP register of western Sweden, obstetric and neonatal records. RESULTS: Children with CP and accompanying impairments more often had low birth weight (kg) (OR 0.5 95% CI; 0.3-0.8), brain maldevelopment known at birth (p=0.007, OR ∞) and neonatal infection (OR 5.4 (1.04-28.4). Moreover, neuroimaging patterns of maldevelopment (OR 7.2 95% CI; 2.9-17.2), cortical/subcortical lesions (OR 5.3 95% CI; 2.3-12.2) and basal ganglia lesions (OR 7.6 95% CI; 1.4-41.3) were more common, wheras white matter injury was found significantly less often (OR 0.2 95% CI; 0.1-0.5). In most children with maldevelopment, the intra- and postpartum period was uneventful (p<0.05). Cerebral maldevelopment was associated with prepartum antecedents,while subcortical/cortical and basal ganglia lesions were associated with intra- and postpartum antecedents. CONCLUSION: No additional factor other than those related to motor impairment was associated with epilepsy and cognitive impairment in CP. Timing of antecedents deemed important for the development of CP with accompanying impairments were supported by neuroimaging patterns. 

PMID: 28295155

**56. Erythropoietin monotherapy in perinatal asphyxia with moderate to severe encephalopathy: a randomized placebo-controlled trial.**

Malla RR, Asimi R, Teli MA, Shaheen F, Bhat MA.

J Perinatol. 2017 Mar 9. doi: 10.1038/jp.2017.17. [Epub ahead of print]

OBJECTIVE: Erythropoietin (EPO) is neuroprotective after asphyxia in animal studies. The efficacy and safety of EPO monotherapy in term neonates with hypoxic ischemic encephalopathy (HIE) is uncertain. STUDY DESIGN: Hundred term neonates with moderate or severe HIE were randomized by random permuted block algorithm to receive either EPO 500 U kg-1 per dose in 2 ml saline intravenously (50 neonates) on alternate days for a total of five doses with the first dose given by 6 h of age (treatment group) or 2 ml of normal saline (50 neonates) similarly for a total of five doses (placebo group) in a double-blind study. No hypothermia was given. The primary outcome was combined end point of death or moderate or severe disability at mean age of 19 months (s.d., 0.61). RESULTS: Death or moderate or severe disability occurred in 40% of neonates in the treatment group vs 70% in the placebo group (risk ratio, 0.57; 95% confidence interval (CI) 0.38 to 0.85; P=0.003). Death occurred in 16% of patients in both the groups (risk ratio, 1.0; 95% CI 0.33 to 2.9; P=0.61). The risk of cerebral palsy was lower among survivors in the treatment group (risk ratio, 0.52; 95% CI 0.25 to 1.03; P=0.04) and lesser number of babies were on anticonvulsants at assessment (risk ratio, 0.47; 95% CI 0.20 to 1.01; P=0.03). Neonatal brain magnetic resonance imaging showed more abnormalities in the placebo group (relative risk, 0.66; 95% CI 0.42 to 1.03; P=0.04)). Improvement in other neurological outcomes was not significant. CONCLUSION: EPO monotherapy reduces the risk of death or disability in term neonates with moderate or severe encephalopathy. Journal of Perinatology advance online publication, 9 March 2017; doi:10.1038/jp.2017.17.

PMID: 28277490

**57. Obesity in pregnancy is related to higher rates of cerebral palsy, study finds.**

Wise J.

BMJ. 2017 Mar 7;356:j1215. doi: 10.1136/bmj.j1215.

[No abstract available].

PMID: 28274915

**58. Variants of the EAAT2 Glutamate Transporter Gene Promoter Are Associated with Cerebral Palsy in Preterm Infants.**

Rajatileka S, Odd D, Robinson MT, Spittle AC, Dwomoh L, Williams M, Harding D, Wagstaff M, Owen M, Crosby C, Ching J, Molnár E, Luyt K, Váradi A.

Mol Neurobiol. 2017 Mar 7. doi: 10.1007/s12035-017-0462-1. [Epub ahead of print]

Preterm delivery is associated with neurodevelopmental impairment caused by environmental and genetic factors. Dysfunction of the excitatory amino acid transporter 2 (EAAT2) and the resultant impaired glutamate uptake can lead to neurological disorders. In this study, we investigated the role of single nucleotide polymorphisms (SNPs; g.-200C>A and g.-181A>C) in the EAAT2 promoter in susceptibility to brain injury and neurodisability in very preterm infants born at or before 32-week gestation. DNA isolated from newborns' dried blood spots were used for pyrosequencing to detect both SNPs. Association between EAAT2 genotypes and cerebral palsy, cystic periventricular leukomalacia and a low developmental score was then assessed. The two SNPs were concordant in 89.4% of infants resulting in three common genotypes all carrying two C and two A alleles in different combinations. However, in 10.6% of cases, non-concordance was found, generating six additional rare genotypes. The A alleles at both loci appeared to be detrimental and consequently, the risk of developing cerebral palsy increased four- and sixfold for each additional detrimental allele at -200 and -181 bp, respectively. The two SNPs altered the regulation of the EAAT2 promoter activity and glutamate homeostasis. This study highlights the significance of glutamate in the pathogenesis of preterm brain injury and subsequent development of cerebral palsy and neurodevelopmental disabilities. Furthermore, the described EAAT2 SNPs may be an early biomarker of vulnerability to neurodisability and may aid the development of targeted treatment strategies.

PMID: 28271401

**59. Association Between Maternal Body Mass Index in Early Pregnancy and Incidence of Cerebral Palsy.**

Villamor E, Tedroff K, Peterson M, Johansson S, Neovius M, Petersson G, Cnattingius S.

JAMA. 2017 Mar 7;317(9):925-936. doi: 10.1001/jama.2017.0945.

IMPORTANCE: Maternal overweight and obesity are associated with increased risks of preterm delivery, asphyxia-related neonatal complications, and congenital malformations, which in turn are associated with increased risks of cerebral palsy. It is uncertain whether risk of cerebral palsy in offspring increases with maternal overweight and obesity severity and what could be possible mechanisms. OBJECTIVE: To study the associations between early pregnancy body mass index (BMI) and rates of cerebral palsy by gestational age and to identify potential mediators of these associations. DESIGN, SETTING, AND PARTICIPANTS: Population-based retrospective cohort study of women with singleton children born in Sweden from 1997 through 2011. Using national registries, children were followed for a cerebral palsy diagnosis through 2012. EXPOSURES: Early pregnancy BMI. MAIN OUTCOMES AND MEASURES: Incidence rates of cerebral palsy and hazard ratios (HRs) with 95% CIs, adjusted for maternal age, country of origin, education level, cohabitation with a partner, height, smoking during pregnancy, and year of delivery. RESULTS: Of 1 423 929 children included (mean gestational age, 39.8 weeks [SD, 1.8]; 51.4% male), 3029 were diagnosed with cerebral palsy over a median 7.8 years of follow-up (risk, 2.13 per 1000 live births; rate, 2.63/10 000 child-years). The percentages of mothers in BMI categories were 2.4% at BMI less than 18.5 (underweight), 61.8% at BMI of 18.5 to 24.9 (normal weight), 24.8% at BMI of 25 to 29.9 (overweight), 7.8% at BMI of 30 to 34.9 (obesity grade 1), 2.4% at BMI of 35 to 39.9 (obesity grade 2), and 0.8% at BMI 40 or greater (obesity grade 3). The number of cerebral

palsy cases in each BMI category was 64, 1487, 728, 239, 88, and 38; and the rates per 10 000 child-years were 2.58, 2.35, 2.92, 3.15, 4.00, and 5.19, respectively. Compared with children of normal-weight mothers, adjusted HR of cerebral palsy were 1.22 (95% CI, 1.11-1.33) for overweight, 1.28 (95% CI, 1.11-1.47) for obesity grade 1, 1.54 (95% CI, 1.24, 1.93) for obesity grade 2, and 2.02 (95% CI, 1.46-2.79) for obesity grade 3. Results were statistically significant for children born at full term, who comprised 71% of all children with cerebral palsy, but not for preterm infants. An estimated 45% of the association between maternal BMI and rates of cerebral palsy in full-term children was mediated through asphyxia-related neonatal morbidity. CONCLUSIONS AND RELEVANCE: Among Swedish women with singleton children, maternal overweight and obesity were significantly associated with the rate of cerebral palsy. The association was limited to children born at full term and was partly mediated through asphyxia-related neonatal complications.

PMID: 28267854