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NEWS
Cerebral Palsy Research

Monday 24 January 2016

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Professor Nadia Badawi AM
Macquarie Group Foundation Chair of Cerebral Palsy

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Interventions and Management

1. Dev Med Child Neurol. 2016 Jan 19. doi: 10.1111/dmcn.13029. [Epub ahead of print]

The significance of hand movement mirroring in cerebral palsy.

Norton J, Sawicka K.

This commentary is on the original article by Klingels et al.

PMID: 26786176

2. Dev Med Child Neurol. 2016 Jan 16. doi: 10.1111/dmcn.13028. [Epub ahead of print]

What does selective motor control of the upper extremity in cerebral palsy tell us?

Gordon AM.

This commentary is on the original article by Wagner et al.

PMID: 26773326

3. Front Pediatr. 2016 Jan 6;3:112. doi: 10.3389/fped.2015.00112. eCollection 2015.

The Corticospinal Tract: A Biomarker to Categorize Upper Limb Functional Potential in Unilateral Cerebral Palsy.

Jaspers E, Byblow WD, Feys H, Wenderoth N.

Children with unilateral cerebral palsy (CP) typically present with largely divergent upper limb sensorimotor deficits and individual differences in response to upper limb rehabilitation. This review summarizes how early brain damage can cause dramatic deviations from the normal anatomy of sensory and motor tracts, resulting in unique "wiring patterns" of the sensorimotor system in CP. Based on the existing literature, we suggest that corticospinal tract (CST) anatomy and integrity constrains sensorimotor function of the upper limb and potentially also the response to treatment. However, it is not possible to infer CST (re)organization from clinical presentation alone and conventional biomarkers, such as time of insult, location, and lesion extent seem to have limited clinical utility. Here, we propose a theoretical framework based on a detailed examination of the motor system using behavioral, neurophysiological, and magnetic resonance imaging measures, akin to those used to predict potential for upper

limb recovery of adults after stroke. This theoretical framework might prove useful because it provides testable hypotheses for future research with the goal to develop and validate a clinical assessment flowchart to categorize children with unilateral CP.

PMID: 26779464

4. J Vis Exp. 2016 Jan 11;(107). doi: 10.3791/53420.

Event-related Potentials During Target-response Tasks to Study Cognitive Processes of Upper Limb Use in Children with Unilateral Cerebral Palsy.

Zielinski IM, Steenbergen B, Baas CM, Aarts P, Jongsma ML.

Unilateral Cerebral Palsy (CP) is a neurodevelopmental disorder that is a very common cause of disability in childhood. It is characterized by unilateral motor impairments that are frequently dominated in the upper limb. In addition to a reduced movement capacity of the affected upper limb, several children with unilateral CP show a reduced awareness of the remaining movement capacity of that limb. This phenomenon of disregarding the preserved capacity of the affected upper limb is regularly referred to as Developmental Disregard (DD). Different theories have been postulated to explain DD, each suggesting slightly different guidelines for therapy. Still, cognitive processes that might additionally contribute to DD in children with unilateral CP have never been directly studied. The current protocol was developed to study cognitive aspects involved in upper limb control in children with unilateral CP with and without DD. This was done by recording event-related potentials (ERPs) extracted from the ongoing EEG during target-response tasks asking for a hand-movement response. ERPs consist of several components, each of them associated with a well-defined cognitive process (e.g., the N1 with early attention processes, the N2 with cognitive control and the P3 with cognitive load and mental effort). Due to its excellent temporal resolution, the ERP technique enables to study several covert cognitive processes preceding overt motor responses and thus allows insight into the cognitive processes that might contribute to the phenomenon of DD. Using this protocol adds a new level of explanation to existing behavioral studies and opens new avenues to the broader implementation of research on cognitive aspects of developmental movement restrictions in children.

PMID: 26780483

5. Neurorehabil Neural Repair. 2016 Jan 20. pii: 1545968315624782. [Epub ahead of print]

Macrostructural and Microstructural Brain Lesions Relate to Gait Pathology in Children With Cerebral Palsy.

Meyns P, Van Gestel L, Leunissen I, De Cock P, Sunaert S, Feys H, Duysens J, Desloovere K, Ortibus E.

BACKGROUND: Even though lower-limb motor disorders are core features of spastic cerebral palsy (sCP), the relationship with brain lesions remains unclear. Unraveling the relation between gait pathology, lower-limb function, and brain lesions in sCP is complex for several reasons; wide heterogeneity in brain lesions, ongoing brain maturation, and gait depends on a number of primary motor functions/deficits (eg, muscle strength, spasticity). OBJECTIVE: To use a comprehensive approach combining conventional MRI and diffusion tensor imaging (DTI) in children with sCP above 3 years old to relate quantitative parameters of brain lesions in multiple brain areas to gait performance. METHODS: A total of 50 children with sCP (25 bilateral, 25 unilateral involvement) were enrolled. The investigated neuroradiological parameters included the following: (1) volumetric measures of the corpus callosum (CC) and lateral ventricles (LVs), and (2) DTI parameters of the corticospinal tract (CST). Gait pathology and primary motor deficits, including muscle strength and spasticity, were evaluated by 3D gait analysis and clinical examination. RESULTS: In bilateral sCP (n = 25), volume of the LV and the subparts of the CC connecting frontal, (pre)motor, and sensory areas were most related to lower-limb functioning and gait pathology. DTI measures of the CST revealed additional relations with the primary motor deficits (n = 13). In contrast, in unilateral sCP, volumetric (n = 25) and diffusion measures (n = 14) were only correlated to lower-limb strength. CONCLUSIONS: These results indicate that the combined influence of multiple brain lesions and their impact on the primary motor deficits might explain a large part of the gait pathology in sCP.

PMID: 26790907

6. Front Physiol. 2016 Jan 6;6:409. doi: 10.3389/fphys.2015.00409. eCollection 2015.

Change of Direction Ability Performance in Cerebral Palsy Football Players According to Functional Profiles.

Reina R, Sarabia JM, Yanci J, García-Vaquero MP, Campayo-Piernas M.

The aims of the present study were to evaluate the validity and reliability of the two different change of direction ability (CODA) tests in elite football players with cerebral palsy (CP) and to analyse the differences in performance of this ability between current functional classes (FT) and controls. The sample consisted of 96 international cerebral palsy football players (FPCP) and 37 football players. Participants were divided into four different groups according to the International Federation of Cerebral Palsy Football (IFCPF) classes and a control group (CG): FT5 (n = 8); FT6 (n = 12); FT7 (n = 62); FT8 (n = 14); and CG (n = 37). The reproducibility of Modified Agility Test (MAT) and Illinois Agility Test (IAT) (ICC = 0.82-0.95, SEM = 2.5-5.8%) showed excellent to good values. In two CODA tests, CG performed faster scores compared with FPCP classes ($p < 0.01$, $d = 1.76$-3.26). In IAT, FT8 class comparisons regarding the other classes were: FT5 ($p = 0.047$, $d = 1.05$), FT6 ($p = 0.055$, $d = 1.19$), and FT7 ($p = 0.396$, $d = 0.56$). With regard to MAT, FT8 class was also compared with FT5 ($p = 0.006$, $d = 1.30$), FT6 ($p = 0.061$, $d = 0.93$), and FT7 ($p = 0.033$, $d = 1.01$). No significant differences have been found between FT5, FT6, and FT7 classes. According to these results, IAT and MAT could be useful and reliable and valid tests to analyse CODA in FPCP. Each test (IAT and MAT) could be applied considering the cut point that classifiers need to make a decision about the FT8 class and the other FT classes (FT5, FT6, and FT7).

PMID: 26779037

7. Stud Health Technol Inform. 2015;219:153-7.

Movement-Based VR Gameplay Therapy For A Child With Cerebral Palsy.

Stansfield S, Dennis C, Larin H, Gallagher C.

This paper presents a single-subject feasibility study of a motion-based VR game designed to provide benefits similar to constraint-induced movement therapy for children with cerebral palsy, while providing a more enjoyable experience. The game was designed to encourage the child to perform the desired therapeutic movements by allowing him to interact with the game using only his more-affected arm. The study used an AB design: Performance across baseline and intervention phases was assessed to determine whether the intervention resulted in changes to repeated measures. Results of the study showed that compared with baseline measurements done prior to his game experience, the participant's post-intervention performance showed improvement in speed of reach, dissociated movement, and bilateral integration of upper extremities in functional tasks. The child's mother, as well as one of his therapists, reported better performance outside of the study environment as well.

PMID: 26799898

8. Ital J Pediatr. 2016 Jan 20;42(1):7. doi: 10.1186/s13052-016-0216-0.

Management of bronchial secretions with Free Aspire in children with cerebral palsy: impact on clinical outcomes and healthcare resources.

Garuti G, Verucchi E, Fanelli I, Giovannini M, Winck JC, Lusuardi M.

BACKGROUND: Management of secretions in children with cerebral palsy is often problematic due to severe deformation of the rib cage, impaired cough, and patients'inability to collaborate with chest physiotherapy. Assessing the effectiveness of different methods and techniques of secretion clearance is hampered by the lack of direct outcome measures and by limited patient cooperation. This observational study was planned to evaluate the efficacy of Free Aspire, a device that utilizes a special method to remove secretions from the bronchial tree in hypersecretive patients. CASE PRESENTATION: Cerebral palsy patients were selected who had experienced more than 3 episodes of respiratory exacerbations in the latest year despite therapeutic optimization (including bronchial clearance techniques) and who had received at least one antibiotic course or underwent at least one access to the Emergency Room (ER) or admission to hospital in the 6 months prior to the study. Patients with

congestive heart failure or contraindications for Free Aspire were excluded. We prospectively enrolled 8 patients (mean age 8.25 ± 6.11 years) who had been using in the past techniques for clearance secretions different from Free Aspire. The treatment with Free Aspire consisted of at least two 20-min sessions per day. The observational study period was 18 months. In the 6 months prior to start the treatment (T0), patients had a mean number of 4.0 ± 2.23 visits from the primary care pediatrician (PCP), spent 14 ± 20 days in hospital, and received antibiotics for 35 ± 17 days. After the first 6 months of treatment (T1), they had 1.7 ± 0.73 PCP visits, no days spent in hospital, and 9.75 ± 10.4 days of antibiotic therapy. At 12 months of treatment (T2), PCP visits were 1.7 ± 0.70, days in hospital 1.12 ± 0.3, and days of antibiotics 10.25 ± 10. At 18 months of treatment (T3) no hospitalizations had occurred, PCP visits were 0.25 ± 0.70, and days of antibiotic therapy 4.8 ± 12.62. The technique proved to be safe and well tolerated. CONCLUSION: Our findings show that Free Aspire for bronchial secretion clearance in cerebral palsy patients with limited capacity to collaborate is safe and effective in reducing the impact of respiratory exacerbations in terms of number of PCP visits, days spent in hospital, and days of antibiotic therapy; its regular use maintains this effect in time.

PMID: 26791415

9. Braz J Phys Ther. 2016 Jan 19. pii: S1413-35552016005000131. [Epub ahead of print]

Reliability of the Brazilian Portuguese version of the Gross Motor Function Measure in children with cerebral palsy.

Almeida KM, Albuquerque KA, Ferreira ML, Aguiar SK, Mancini MC.

OBJECTIVE: To test the intra- and interrater reliability of the Brazilian Portuguese version of the 66-item Gross Motor Function Measure (GMFM-66). METHOD: The sample included 48 children with cerebral palsy (CP), ranging from 2-17 years old, classified at levels I to IV of the Gross Motor Function Classification System (GMFCS) and four child rehabilitation examiners. A main examiner evaluated all children using the GMFM-66 and video-recorded the assessments. The other examiners watched the video recordings and scored them independently for the assessment of interrater reliability. For the intrarater reliability evaluation, the main examiner watched the video recordings one month after the evaluation and re-scored each child. We calculated reliability by using intraclass correlation coefficients (ICC) with their respective 95% confidence intervals. RESULTS: Excellent test reliability was documented. The intrarater reliability of the total sample was ICC=0.99 (95% CI 0.98-0.99), and the interrater reliability was ICC=0.97 (95% CI 0.95-0.98). The reliability across GMFCS levels ranged from ICC=0.92 (95% CI 0.72-0.98) to ICC=0.99 (95% CI 0.99-0.99); the lowest value was the interrater reliability for the GMFCS IV group. Reliability in the five GMFM dimensions varied from ICC=0.95 (95% CI 0.93-0.97) to ICC=0.99 (95% CI 0.99-0.99). CONCLUSION: The Brazilian Portuguese version of the GMFM-66 showed excellent intra- and interrater reliability when used in Brazilian children with CP levels GMFCS I to IV.

PMID: 26786081

10. Dev Med Child Neurol. 2016 Jan 16. doi: 10.1111/dmcn.13031. [Epub ahead of print]

Use of standardized outcome measures should be common place in the clinical care of children with cerebral palsy: why isn't it?

Oeffinger D.

This commentary is on the original article by O'Connor et al.

PMID: 26773442

11. Ann Rehabil Med. 2015 Dec;39(6):914-21. doi: 10.5535/arm.2015.39.6.914. Epub 2015 Dec 29.

Therapeutic Effect of Extracorporeal Shock Wave Therapy According to Treatment Session on Gastrocnemius Muscle Spasticity in Children With Spastic Cerebral Palsy: A Pilot Study.

Park DS, Kwon DR, Park GY, Lee MY.

OBJECTIVE: To investigate the therapeutic effect of extracorporeal shockwave therapy (ESWT) according to treatment session on gastrocnemius muscle spasticity in children with spastic cerebral palsy (CP). METHODS: Twelve children with spastic CP underwent 1 ESWT and 2 sham ESWT sessions for gastrocnemius (group 1) or 3 ESWT sessions (group 2) once per week for 3 weeks. Modified Ashworth Scale (MAS) score, passive range of motion (PROM) of the ankle plantar-flexor muscles with knee extension, and median red pixel intensity (RPI) of color histogram of medial gastrocnemius on real-time sonoelastography (RTS) were measured before ESWT, immediately after the first and third ESWT, and at 4 weeks after the third ESWT. RESULTS: Mean ankle PROM was significantly increased whereas as mean ankle MAS and median gastrocnemius RPI were significantly decreased in both groups after the first ESWT. Clinical and RTS parameters before ESWT were not significantly different from those immediately after the third ESWT or at 4 weeks after the third ESWT in group 1. However, they were significantly different from those immediately after the third ESWT or at 4 weeks after the third ESWT in group 2. Mean ankle PROM, mean ankle MAS, and median gastrocnemius RPI in group 2 were significantly different from that in group 1 at 4 weeks or immediately after the third ESWT. CONCLUSION: The therapeutic effect of ESWT on spastic medial gastrocnemius in children with spastic CP is dependent on the number of ESWT sessions.

PMID: 26798605

12. Can J Neurol Sci. 2016 Jan 21:1-6. [Epub ahead of print]

Perinatal Regionalization and Implications for Long-Term Health Outcomes in Cerebral Palsy.

Bolbocean C, Wintermark P, Shevell MI, Oskoui M.

BACKGROUND: Perinatal regionalization is linked to improved neonatal outcomes; however, the effects on long-term outcomes in cerebral palsy (CP) are not known. We estimate the effect of highest levels of neonatal care available at delivery on the risk of developing a nonambulatory CP status. METHODS: Children with CP born in Quebec from the Canadian CP Registry excluding postneonatal causes were included (N=360). We estimate the effect of level of care available at delivery on risk of nonambulatory status among children with CP using propensity score matching and instrumental variables methods to adjust for differences in case mix among the three groups of hospitals. The outcome variable is an indicator for CP nonambulation assigned according to Gross Motor Function Classification System (levels IV and V). This study used data that predated therapeutic hypothermia in Quebec. RESULTS: Propensity score estimates of change in the adjusted risk of having a nonambulatory CP status because of birth at level II versus level I is -0.081, 95% confidence interval (CI; -0.2182 to 0.0562); level III versus level I is -0.072 95% CI (-0.225 to 0.08), and level III versus level II is 0.157 95% CI (0.027 to 0.286). CONCLUSIONS: Differences in levels of neonatal care available at hospital where the delivery was carried out are not associated with the risk of a nonambulatory CP phenotype. This suggests that level of care and associated medical technology within the Quebec regionalized neonatal-perinatal system is used efficiently because it does not offer any further marginal benefit in the reduction of severe CP outcomes. The system works well as it is, which is supportive of the perinatal regionalization. The success of the neonatal resuscitation program and referral of high-risk births to regional hospitals with sufficient obstetric and perinatal competence and resources may contribute to this lack of variability.

PMID: 26790470

13. Res Dev Disabil. 2016 Feb-Mar;49-50:312-21. doi: 10.1016/j.ridd.2015.12.011. Epub 2016 Jan 11.

Do environmental barriers affect the parent-reported quality of life of children and adolescents with cerebral palsy?

Badia M, Begoña Orgaz M, Gómez-Vela M, Verdugo MA, Ullán AM, Longo E.

Physical, social, and attitudinal environment may affect the quality of life (QoL) of children and adolescents with cerebral palsy (CP). Participants in this study included parents of 206 children and adolescents with CP (55.8% males) aged 8-18 years (M=11.96, SD=3). Distribution according to the Gross Motor Function Classification System (GMFCS) was 24.3% level I, 18% level II, 18% level III, 12.6% level IV, and 27.2 level V. Environmental barriers were assessed with the Spanish version of the European Child Environment Questionnaire (ECEQ), and QoL was assessed with the KIDSCREEN parents' version. The results of the correlation analysis revealed that GMFCS level, IQ, and type of schooling are significantly correlated with QoL. Barriers were also associated with QoL. A series of hierarchical regression analyses indicated that, after controlling for the effect of child and parent's variables, barriers at home and at school significantly contribute to QoL. These findings underscore the importance of providing interventions to produce environmental changes that contribute to the improvement of QoL.

PMID: 26788697

Prevention and Cure

14. BJOG. 2016 Jan 15. doi: 10.1111/1471-0528.13861. [Epub ahead of print]

Cerebral palsy: the obstetrician is 'off the hook'…almost.

Oláh K.

This is a mini commentary on KM Strand et al.

PMID: 26773966

15. Mol Neurobiol. 2016 Jan 19. [Epub ahead of print]

COX-1 and COX-2 polymorphisms in susceptibility to cerebral palsy in very preterm infants.

Kapitanović Vidak H, Catela Ivković T, Vidak Z, Kapitanović S.

Cerebral palsy (CP) is a nonprogressive motor disorder caused by white matter damage in the developing brain. Recent epidemiological and clinical data suggest intrauterine infection/inflammation as the most common cause of preterm delivery and neonatal complications, including CP. Cyclooxygenases are key enzymes in the conversion of arachidonic acid to prostaglandins. The COX family consists of two isoforms, COX-1 and COX-2. In the brain, COX-2 is constitutively expressed at high levels on pyramidal neurons, while COX-1 is predominantly expressed by microglia and can be upregulated in pathological conditions, such as infection, ischemia and traumatic brain injury. Single nucleotide polymorphisms in the COX-1 and COX-2 gene could have profound effects on COX-1 and COX-2 expression and, directly or indirectly, influence the pathogenesis, development and severity of CP. In this study we investigated the association between single nucleotide polymorphisms of the COX-1 and COX-2 gene and susceptibility to cerebral palsy in very preterm infants. The results of our study showed the association between COX-1 high expression genotype (-842 AA) and COX-1 high expression allele -842A and risk of CP in infants with cystic periventricular leucomalacia (cPVL). Our results support an important role of COX-1 enzyme on microglial activation during neuroinflammation resulting in huge neuroinflammatory response and the proinflammatory mediator overproduction, with the serious white matter damage and CP development as a consequence.

PMID: 26781425

16. Pediatrics. 2016 Jan 20. pii: peds.2015-2848. [Epub ahead of print]

Parechovirus Encephalitis and Neurodevelopmental Outcomes.

Britton PN, Dale RC, Nissen MD, Crawford N, Elliot E, Macartney K, Khandaker G, Booy R, Jones CA; PAEDS-ACE Investigators.

OBJECTIVE: We aimed to describe the clinical features and outcome of human parechovirus (HPeV) encephalitis cases identified by the Australian Childhood Encephalitis (ACE) study. METHODS: Infants with suspected encephalitis were prospectively identified in 5 hospitals through the (ACE) study. Cases of confirmed HPeV infection had comprehensive demographic, clinical, laboratory, imaging, and outcome at discharge data reviewed by an expert panel and were categorized by using predetermined case definitions. Twelve months after discharge, neurodevelopment was assessed by using the Ages and Stages Questionnaire (ASQ). RESULTS: We identified thirteen cases of suspected encephalitis with HPeV infection between May 2013 and December 2014. Nine infants had confirmed encephalitis; median age was 13 days, including a twin pair. All had HPeV detected in cerebrospinal fluid with absent pleocytosis. Most were girls (7), admitted to ICU (8), and had seizures (8). Many were born preterm (5). Seven patients had white matter diffusion restriction on MRI; 3 with normal cranial ultrasounds. At discharge, 3 of 9 were assessed to have sequelae; however, at 12 months' follow-up, by using the ASQ, 5 of 8 infants showed neurodevelopmental sequelae: 3 severe (2 cerebral palsy, 1 central visual impairment). A further 2 showed concern in gross motor development. CONCLUSIONS: Children with HPeV encephalitis were predominantly young, female infants with seizures and diffusion restriction on MRI. Cranial ultrasound is inadequately sensitive. HPeV encephalitis is associated with neurodevelopmental sequelae despite reassuring short-term outcomes. Given the absent cerebrospinal fluid pleocytosis and need for specific testing, HPeV could be missed as a cause of neonatal encephalopathy and subsequent cerebral palsy.

PMID: 26791970

17. Dev Med Child Neurol. 2016 Feb;58(2):109. doi: 10.1111/dmcn.13008.

The Mexican Academy for Cerebral Palsy and Neurodevelopmental Disorders: new kid on the block.

Delgado MR.

The American Academy of Cerebral Palsy (AACP) was founded in 1947 by a multidisciplinary group of physicians and surgeons who understood the complexity of cerebral palsy (CP), both in diagnosis and treatment. Over the next three decades, the AACP expanded its scope to include comorbidities that affect patients with CP and other developmental disorders. The increased interest in disorders of communication, behavior, attention, learning, and psychosocial problems attracted other involved professionals to the annual meetings – not least psychologists, speech pathologists, and teachers. In 1976 the AACP changed its name to the American Academy for Cerebral Palsy and Developmental Medicine (AACPDM) to represent and advocate not only for those affected by CP but also those with any childhood-onset disability.[1] For nearly 70 years, the AACPDM has attracted professionals from all over the world, which led to the formation in 1986 of an International Affairs Committee. However, due to language barriers, geographical distance, and economic realities, many members were unable to attend AACPDM meetings and take advantage of its educational opportunities. So in 2014 the AACPDM partnered with the European Academy of Childhood Disability (EACD) and the Australasian Academy of Cerebral Palsy and Developmental Medicine (AusACPDM) to found the International Alliance of Academies of Childhood Disability (IAACD).[2] The goals of the IAACD are: to promote teaching and training for multidisciplinary professionals and caretakers in all aspects of childhood disability; to foster collaboration between all involved in the care of children and young people with disabilities including parents, caretakers, professionals, and communities; to partner with key individuals and organizations in support of the rights and privileges of children and young people with disabilities; to promote scientific and needs-driven research in childhood disability and to facilitate dissemination of results; to translate research findings into clinical practice across different regions and cultures; and to establish and implement a set of fundamental ethical and scientific standards for the IAACD and member academies. This global initiative has triggered widespread and enthusiastic interest in creating new academies around the world. These new academies may eventually join this international effort and bring us all closer together. In September 2014 a multidisciplinary group of Mexican health professionals met at the AACPDM annual meeting in San Diego, California to discuss the idea of creating a Mexican Academy. The group included neurologists, physiatrists, orthopedic surgeons, pediatricians, and a physical therapist. On March 9th, 2015 the Mexican Academy for Cerebral Palsy and Neurodevelopmental Disorders (AMexPCTND) was legally constituted in that country

(www.amexpctnd.org). The mission of this newly formed academy is to provide evidence-based multidisciplinary education to professionals involved in the care of patients with CP and other neurodevelopmental disorders, and to promote excellence in research and services that may benefit these patients in that country and other regions of Latin America. The AMexPCTND will have its first annual meeting from February 26th to 28th, 2016 in Mexico City, to be attended by national and international experts. The AMexPCTND looks forward to becoming a member of the IAACD. Congratulations to the leadership of this newly formed academy, the new kid on the block.

PMID: 26800500

18. Dev Med Child Neurol. 2016 Feb;58(2):108. doi: 10.1111/dmcn.13009.

Are registers the future for research in cerebral palsy?

Chambers H.

The criterion standard for research in all medical fields is the randomized clinical trial (RCT). Done correctly, this design enables the researcher to pose a question prospectively, assemble two groups – one of which is a control group and the other the experimental group – and determine if the intervention leads to differences between the two. Since RCTs are so highly valued, why are there so few of them in our field?[1] Firstly, there are several problems in creating large, informative, comparable groups. Secondly, the cost for large double-blind RCTs is huge, which restricts research to major centers that have the necessary expertise and infrastructure; it also restricts access to major grants from governments or industry (the latter possibly inducing biases).[2] Third, generalizability of the results to individuals who have one of the exclusion criteria may be difficult. So what should we do in the field of cerebral palsy (CP) and other developmental disabilities to evaluate effectiveness?[2] The answer might be clinical effectiveness research (CER) – perhaps the future of our field? Simply stated, CER is a method in which one treats a group of patients the way that one thinks is best for the particular patients' issues. The difference between this and regular clinical practice is that there a systematic way, using validated instruments, to collect data prior to intervention and at routine intervals after the intervention. Various statistical techniques are applied and research questions can be answered. This is 'real world' research, without any inclusion or exclusion criteria. In order to house all these data, one must have a repository of the information, hence the huge interest in registers. A register (or registry) involves enrolling a population in a computerized database with a prescribed set of common data elements. At regular intervals, usually when there is some sort of intervention, another set of validated instruments is used to evaluate the patients. Participation of many centers would result in a very large database to study. With a register, one could query the database to find, for example, all of the patients with bilateral CP who had mild dystonia, upper extremity contractures and seizure disorders. By comparing different approaches (oral medications, botulinum toxin, surgery, therapies) it is possible to tease out the factors that made one approach more successful than the others. The use of CER and registers is not as methodologically rigorous as the RCT, but given the challenges of the RCT, CER and registers provide counterpoints. In theory, all the patients in one's practice could be enrolled. The results of these studies are generalizable (to the patient you are treating); the studies are relatively inexpensive (still very expensive, but not on the scale of a large RCT); and the research does not have to be performed in large universities, but can be done in smaller community settings. This type of study also allows one to follow a patient for years – essential in our patient population – rather than until grant money runs out! It does take a lot of investigator time to enroll and continue to follow a subject, but for those who have been involved in registers, the research output is tremendous. Certainly, I do not advocate eliminating randomized double-blind clinical trials. However, to move our field forward, we must utilize CER and registers to obtain a more generalizable real-world understanding of the natural history and what 'works' in our field.

PMID: 26800499

Special Edition - Part publication of the Australian Cerebral Palsy Register Supplement

1. Foreword
Article first published online: 19 JAN 2016 | DOI: 10.1111/dmcn.13006
Christine Cans and Nicole Gerrand

Wiley Online: http://onlinelibrary.wiley.com/doi/10.1111/dmcn.13006/abstract

2. Acknowledgements
Article first published online: 19 JAN 2016 | DOI: 10.1111/dmcn.13003

Wiley Online: http://onlinelibrary.wiley.com/doi/10.1111/dmcn.13003/abstract

3. Australia and the Australian Cerebral Palsy Register for the birth cohort 1996-2006

Australian Cerebral Palsy Register Group

Not yet available online

PMID: Not yet available

4. Dev Med Child Neurol. 2016 Jan 13. doi: 10.1111/dmcn.13026. [Epub ahead of print]

A special supplement: findings from the Australian Cerebral Palsy Register, birth years 1993 to 2006.

Smithers-Sheedy H, McIntyre S, Gibson C, Meehan E, Scott H, Goldsmith S, Watson L, Badawi N, Walker K, Novak I, Blair E; Australian Cerebral Palsy Register Group.

AIM: To briefly outline the strengths and limitations of cerebral palsy (CP) registers, and to report on findings of the Australian Cerebral Palsy Register (ACPR) pertaining to a population cohort of children with CP. METHOD: De-identified data were extracted from the ACPR for people with CP in birth years 1993 to 2006, from South Australia, Victoria, and Western Australia. Live birth prevalence of CP was estimated and risk factors described. RESULTS: The overall birth prevalence of CP (including those whose CP was postneonatally acquired) for the 1993 to 2006 birth cohort was 2.1 per 1000 live births (95% confidence interval [CI] 2.0-2.2). Excluding cases with a known postneonatal cause, the birth prevalence for pre/perinatally acquired CP was 2.0 per 1000 live births (95% CI 1.9-2.1). A downward trend in rates of CP in those born extremely preterm was evident over at least three consecutive periods across all three regions. Most (58.6%) children were born at term (≥37wks). Male sex, early gestational age, low birthweight, and multiple birth were risk factors for CP. INTERPRETATION: Overall rates of CP did not change during this period. The proportion of those with CP born extremely preterm decreased. The ACPR Group will investigate whether this pattern continues when data pertaining to the next birth cohort for all three regions becomes available.

PMID: 26762930

5. Dev Med Child Neurol. 2016 Jan 19. doi: 10.1111/dmcn.12999. [Epub ahead of print]

An international survey of cerebral palsy registers and surveillance systems.

Goldsmith S, McIntyre S, Smithers-Sheedy H, Blair E, Cans C, Watson L, Yeargin-Allsopp M, Australian Cerebral Palsy Register Group.

AIM: To describe cerebral palsy (CP) surveillance programmes and identify similarities and differences in governance and funding, aims and scope, definition, inclusion/exclusion criteria, ascertainment and data collection,

to enhance the potential for research collaboration. METHOD: Representatives from 38 CP surveillance programmes were invited to participate in an online survey and submit their data collection forms. Descriptive statistics were used to summarize information submitted. RESULTS: Twenty-seven surveillance programmes participated (25 functioning registers, two closed owing to lack of funding). Their aims spanned five domains: resource for CP research, surveillance, aetiology/prevention, service planning, and information provision (in descending order of frequency). Published definitions guided decision making for the definition of CP and case eligibility for most programmes. Consent, case identification, and data collection methods varied widely. Ten key data items were collected by all programmes and a further seven by at least 80% of programmes. All programmes reported an interest in research collaboration. INTERPRETATION: Despite variability in methodologies, similarities exist across programmes in terms of their aims, definitions, and data collected. These findings will facilitate harmonization of data and collaborative research efforts, which are so necessary on account of the heterogeneity and relatively low prevalence of CP.

PMID: 26781543

6. Dev Med Child Neurol. 2016 Jan 14. doi: 10.1111/dmcn.13000. [Epub ahead of print]

Interobserver reliability of the Australian Spasticity Assessment Scale (ASAS).

Love S, Gibson N, Smith N, Bear N, Blair E; Australian Cerebral Palsy Register Group.

AIM: The aim of this paper is to present the Australian Spasticity Assessment Scale (ASAS) and to report studies of its interrater reliability. The ASAS identifies the presence of spasticity by confirming a velocity-dependent increased response to rapid passive movement and quantifies it using an ordinal scale. METHOD: The rationale and procedure for the ASAS is described. Twenty-two participants with spastic CP (16 males; age range 1y 11mo-15y 3mo) who had not had botulinum neurotoxin-A within 4 months, or bony or soft tissue surgery within 12 months, were recruited from the spasticity management clinic of a tertiary paediatric teaching hospital. Fourteen muscles in each child were assessed by each of three experienced independent raters. ASAS was recorded for all muscles. Interrater reliability was calculated using the weighted kappa statistic (quadratic weighting; κqw) for individual muscles, for upper limbs, for lower limbs, and between raters. RESULTS: The weighted kappa ranged between 0.75 and 0.92 for individual muscle groups and was 0.87 between raters. INTERPRETATION: The ASAS complies with the definition of spasticity and is clinically feasible in paediatric settings. Our estimates of interrater reliability for the ASAS exceed that of the most commonly used spasticity scoring systems.

PMID: 26762706

7. Dev Med Child Neurol. 2016 Jan 13. doi: 10.1111/dmcn.13001. [Epub ahead of print]

Temporal trends in cerebral palsy by impairment severity and birth gestation.

Reid SM, Meehan E, McIntyre S, Goldsmith S, Badawi N, Reddihough DS; Australian Cerebral Palsy Register Group.

AIM: Our aim was to build on previous research indicating that rates of cerebral palsy (CP) in the Australian state of Victoria are declining, and examine whether severity of impairments is also decreasing. METHOD: Data on individuals with CP were extracted from the Victorian Cerebral Palsy Register for birth years 1983 to 2009. The yearly rates of dichotomized categories for gross motor function, motor laterality, intellectual impairment, and epilepsy per 1000 neonatal survivors and proportions in the CP cohort were tabulated and plotted by birth gestation. Linear regression modelling was used to fit prediction curves; likelihood ratio tests were used to test for differences in trends between impairment severity groups. RESULTS: Since the mid-1990s, CP rates declined in neonatal survivors of birth at all gestations. Our data suggest that the decreasing CP rates were associated with relatively greater decreases in the rates of Gross Motor Function Classification System levels III to V, bilateral CP, epilepsy, and intellectual impairment (all $p<0.005$). Some variation was seen between birth gestation groups. INTERPRETATION: Declines in rates of CP of all levels of severity and complexity from the mid-1990s provides 'real-world' support for the effectiveness of concurrent neuroprotective strategies and continual innovation in perinatal practices.

PMID: 26762733

8. Dev Med Child Neurol. 2016 Jan 19. doi: 10.1111/dmcn.13005. [Epub ahead of print]

Comparing risks of cerebral palsy in births between Australian Indigenous and non-Indigenous mothers.

Blair E, Watson L, Okearney E, Dantoine H, Delacy M; Australian Cerebral Palsy Register Group.

AIM: To compare proportions of live births subsequently described as having cerebral palsy (CP), the distributions of associated impairments, and the causes of postneonatal CP between Aboriginal and Torres Strait Islander (Indigenous) and non-Indigenous populations in Australia. METHOD: Data from statutory birth records and CP registers for the 1996 to 2005 birth cohort in Queensland, Western Australia, and the Northern Territory were stratified by Indigenous status and whether the CP was acquired pre/perinatally or postneonatally. Relative risks associated with Indigenous status were estimated and the distributions of causes of postneonatal CP compared. RESULTS: Indigenous births had a relative risk of 4.9 (95% confidence interval [CI] 3.0-7.9) for postneonatal CP but only of 1.42 (95% CI 1.2-1.7) for pre/perinatal CP. Almost half of postneonatal CP in Indigenous infants resulted from infection, whereas for non-Indigenous infants the most frequent cause was cerebrovascular accident. The impairments of Indigenous CP and of postneonatally acquired CP tended to be more numerous and more severe. INTERPRETATION: Indigenous children are at significantly greater risk of CP, particularly postneonatal CP. The predominant cause of postneonatal CP in non-Indigenous children has shifted to cerebrovascular accident over time; however, infections followed by head injury are still the most frequent causes in Indigenous infants.

PMID: 26781773

9. Dev Med Child Neurol. 2016 Jan 14. doi: 10.1111/dmcn.13021. [Epub ahead of print]

Biological sex and the risk of cerebral palsy in Victoria, Australia.

Reid SM, Meehan E, Gibson CS, Scott H, Delacy M; Australian Cerebral Palsy Register Group.

AIM: Males typically outnumber females in cerebral palsy (CP) cohorts. To better understand this 'male disadvantage' and provide insight into causal pathways to CP, this study used 1983 to 2009 Australian CP and population birth cohorts to identify associations and trends with respect to biological sex and CP. METHOD: Within birth gestation groups, sex ratios were calculated to evaluate any male excess in the CP cohort compared with livebirths, neonatal deaths, neonatal mortality and survival rates, neonatal survivors, and CP rates in survivors. Sex - and gestation-specific trends in neonatal mortality, CP rates, and CP sex ratios were assessed by plotting their annual frequencies and fitting quadratic curves. RESULTS: Over-representation of males in preterm live births partly explained the male excess in the CP cohort after preterm birth, especially at 28 to 31 weeks. Higher CP rates in male neonatal survivors also contributed to the male excess in CP, particularly at <28 and 37+ weeks. Higher neonatal mortality rates in males at all gestations had little impact on the CP sex ratio. There was no clearly discernible change over time in the CP sex ratio. INTERPRETATION: Gestation-specific associations between sex and CP provide insight into causal pathways to CP and suggest sex-specific differences in response to neuroprotective strategies.

PMID: 26762863

10. Dev Med Child Neurol. 2016 Jan 17. doi: 10.1111/dmcn.13012. [Epub ahead of print]

Profile of associated impairments at age 5 years in Australia by cerebral palsy subtype and Gross Motor Function Classification System level for birth years 1996 to 2005.

DeLacy MJ, Reid SM; Australian cerebral palsy register group.

AIM: To describe the distribution of impairments among persons with cerebral palsy (CP) in a large Australian cohort. METHOD: Records of persons on the Australian Cerebral Palsy Register (ACPR) (n=3466) born from 1996 to 2005 were reviewed to extract year of birth, sex, CP subtype, Gross Motor Function Classification System (GMFCS) level, and impairments in vision, hearing, speech, intellect, and epilepsy. The distributions of GMFCS levels and CP subtype were plotted, and the proportions of each level of impairment were tabulated and presented as stacked graphs within the GMFCS and CP subtype distributions. RESULTS: The proportions of persons with CP with each associated impairment increased with increasing GMFCS level. Compared with other spastic CP

subtypes, individuals with spastic quadriplegia had higher frequencies of all associated impairments. Other than epilepsy, which was most prevalent in persons with spastic quadriplegia (53%), all impairments were most frequent in non-spastic CP subtypes. Hearing impairment was recorded for 21% of persons with dyskinesia whereas the hypotonic subtype had the highest prevalence of visual impairment (57%), intellectual impairment (90%), and speech impairment (95%). INTERPRETATION: Distributions of associated impairments across all GMFCS levels and CP subtypes in a large cohort are presented in formats suitable for clinical use and discussion with families.

PMID: 26777873

11. Dev Med Child Neurol. 2016 Jan 14. doi: 10.1111/dmcn.13020. [Epub ahead of print]

Strabismus, a preventable barrier to social participation: a short report.

Blair E, Smithers-Sheedy H; Australian Cerebral Palsy Register Group.

Isolated strabismus does not significantly impair visual functionality and has traditionally been considered a primarily cosmetic defect of little importance. However, even in the absence of strabismus amblyopia, manifest strabismus and its non-surgical treatments can render the person less socially acceptable, creating a barrier to participation and resulting in psychosocial disadvantage that has been documented in the typically developing population. The Australian Cerebral Palsy Register traditionally recorded strabismus only if it were not accompanied by visual impairment; however, even these data indicate that the proportion of cerebral palsy registrants with strabismus is many times higher than in comparable population samples, compounding their challenges to achieve participation. It is therefore inappropriate to continue to consider strabismus as merely a cosmetic defect, but one that deserves surgical correction early in life.

PMID: 26762817

12. Change in residential remoteness during the first 5 years of life in an Australian cerebral palsy cohort

Michael J DeLacy, Christalla Louca, Hayley Smithers-Sheedy, Sarah McIntyre and on behalf of the Australian Cerebral Palsy Register Group

Aim: To determine if families of children with cerebral palsy living in Australia move to less remote areas between birth and 5 years. Method: Children on the Australian Cerebral Palsy Register (n=3399) born 1996 to 2005, were assigned a remoteness value for family residence at birth and 5 years using a modification of the Australian Statistical Geography Standard. Each value at birth was subtracted from the value at 5 years yielding a positive difference if they moved more remotely, negative difference if they moved less remotely and a value of zero if they did not move or moved to an equally remote residence. Results: The small net increase in remoteness across this cohort was non-significant (p=0.43). Fifty-seven per cent of families changed postcode but only 20% changed remoteness, 11% more remotely, and 9% less remotely. There was a small trend for families with a child with more impaired gross motor function (Gross Motor Function Classification System levels IV and V) to move to a less remote area. Interpretation: This cohort of families with children with cerebral palsy did not appear to move to less remote areas by age 5 years. Remoteness at birth and level of gross motor function seem to have little effect.

Wiley Online: http://onlinelibrary.wiley.com/doi/10.1111/dmcn.13013/abstract
PMID: Not yet available

13. Dev Med Child Neurol. 2016 Jan 19. doi: 10.1111/dmcn.13007. [Epub ahead of print]

The National Disability Insurance Scheme: a time for real change in Australia.

Reddihough DS, Meehan EM, Stott NS, Delacy M; Australian Cerebral Palsy Register Group.

In Australia, the supports and services for persons with disabilities have long been underfunded and fragmented. Often, individuals did not receive the services they needed, but rather the services they were entitled to based on how or when they acquired their disability. As a result, there was an increasing reliance on ageing carers, a lack of

permanent and respite accommodation, and reduced employment and educational opportunities. Individuals with disabilities and their families were often isolated and financially disadvantaged. In March 2013, legislation was passed in Australia to establish a National Disability Insurance Scheme, a radical new way of funding disability services. No longer would funding be directed to agencies, but rather to individuals who would make their own plan and select their preferred services and service providers, giving them more control over the services and supports they receive. The hope is that this change from a welfare-driven to an insurance-based model will improve equity of service delivery, levels of participation, and overall quality of life among Australians with disabilities and their families.

PMID: 26782069

14. Dev Med Child Neurol. 2016 Jan 14. doi: 10.1111/dmcn.13015. [Epub ahead of print]

Congenital anomalies in cerebral palsy: where to from here?

McIntyre S, Blair E, Goldsmith S, Badawi N, Gibson C, Scott H, Smithers-Sheedy H; Australian Cerebral Palsy Register Group.

Proportions of cases of cerebral palsy (CP) with congenital anomalies recorded in Australian CP registers range from 15% to 40%. The anomalies seen in CP are extremely variable. We have identified that CP registers often do not have quality data on congenital anomalies, necessitating linkage with congenital anomaly registers. However, a lack of unified processes and definitions in congenital anomaly registers and data collections means that linkages are complex, need to be carefully planned, and limitations acknowledged. Historically in CP research, congenital anomalies have been classified by International Classification of Disease codes, then combined into brain and other major and minor anomalies. Systems have been developed to classify congenital anomalies into aetiologically related groups, but such a classification has yet to be trialled in CP. It is anticipated that primary prevention of a small proportion of cases of CP is possible through the primary prevention of congenital anomalies, especially those due to teratogens. Owing to the anticipated low prevalence of each subgroup, global collaboration will be required to further these lines of enquiry.

PMID: 26762782

15. Dev Med Child Neurol. 2016 Jan 14. doi: 10.1111/dmcn.13014. [Epub ahead of print]

Cerebral palsy and perinatal mortality after pregnancy-induced hypertension across the gestational age spectrum: observations of a reconstructed total population cohort.

Blair E, Watson L; Australian Cerebral Palsy Register Group.

AIM: Pregnancy-induced hypertension/pre-eclampsia (PIH/PE) is associated with cerebral palsy (CP) in term births but if sufficiently severe to necessitate preterm delivery predicts a lower risk of CP than observed in gestational peers. We investigated whether this apparent 'protection' was attributable to inappropriately chosen comparison groups and/or an increased risk of perinatal death. METHOD: Perinatal information was collected from medical records of children with CP, individually matched neonatal survivors without CP, and representative samples of perinatal deaths of Western Australian birth cohorts from 1980 to 1995. Compared with these data, the sensitivity of statutorily collected PIH/PE data was assessed for each outcome group. Using these sensitivities, the estimated risks of death and CP in births to all women with and without PIH/PE were compared. RESULTS: Sensitivity of statutory PIH/PE data decreased with increasingly poor outcome. Reconstructed cohorts showed that PIH/PE increased the risks both of CP and of perinatal death in births at lower gestations except in births <27 weeks, where the risk of perinatal death only increased greatly. INTERPRETATION: PIH/PE does not protect against poor outcome at any gestational age. Previously reported protective effects originate from inappropriate control for gestational age and not from higher gestation-specific perinatal mortality.

PMID: 26762763