

Monday 18 July 2016

Cerebral Palsy Alliance is delighted to bring you this free weekly bulletin of the latest published research into cerebral palsy. Our organisation is committed to supporting cerebral palsy research worldwide - through information, education, collaboration and funding. Find out more at research.cerebralpalsy.org.au

Professor Nadia Badawi AM

Macquarie Group Foundation Chair of Cerebral Palsy

[Subscribe to CP Research News](#)

Please note: This research bulletin represents only the search results for cerebral palsy and related neurological research as provided by the PubCrawler service. The articles listed below do not represent the views of Cerebral Palsy Alliance.

Interventions and Management

1. Gait Posture. 2016 Jun 27;49:132-135. doi: 10.1016/j.gaitpost.2016.06.033. [Epub ahead of print]

The arm posture in children with unilateral Cerebral Palsy is mainly related to antero-posterior gait instability.

Meyns P, Duysens J, Desloovere K.

In this observational case-control study we aimed to determine whether altered arm postures in children with unilateral CP (uniCP) are related to gait instability in a specific direction. Antero-posterior and medio-lateral Foot Placement Estimator instability measures and arm posture measures (vertical and antero-posterior hand position, sagittal and frontal upper arm elevation angle) were determined in eleven uniCP (7 years-10 months) and twenty-four typically developing children (9 years-6 months) at two walking speeds. Spearman-rank correlation analyses were made to examine the relationship between antero-posterior and medio-lateral arm posture and gait instability. Arm posture in both planes was related to antero-posterior instability (e.g. sagittal and frontal upper arm elevation angle correlated moderately with antero-posterior instability; $R=0.41$, $p<0.001$, $R=-0.47$, $p<0.001$). In uniCP, increased antero-posterior instability was associated with a higher ($R=-0.62$, $p=0.002$) and more frontal position of the hemiplegic hand ($R=-0.58$, $p=0.005$), while the non-hemiplegic upper arm was rotated more backward ($R=0.63$, $p=0.002$) and both upper arms rotated more sideways (hemiplegic: $R=-0.58$, $p=0.004$; non-hemiplegic: $R=-0.55$, $p=0.008$). The altered non-hemiplegic (sagittal and frontal) arm posture in uniCP may be a compensation to reduce antero-posterior gait instability.

[PMID: 27414040](#)

2. Gait Posture. 2016 Jun 23;49:102-107. doi: 10.1016/j.gaitpost.2016.06.029. [Epub ahead of print]

Three-dimensional evaluation of skeletal deformities of the pelvis and lower limbs in ambulant children with cerebral palsy. Massaad A, Assi A, Bakouny Z, Sauret C, Khalil N, Skalli W, Ghanem I.

Skeletal abnormalities, affecting posture and walking pattern, increase with motor impairment in children with cerebral palsy (CP). However, it is not known whether these skeletal malalignments occur in children with slight motor impairment. Our aim was to evaluate skeletal malalignment at the level of the pelvis and lower limbs in ambulant children with CP, with slight motor impairment, using a low dose biplanar X-ray technique. Twenty-seven children with spastic CP (mean age: 10.9 ± 4 years, 7 Hemiplegia, 20 Diplegia, GMFCS levels I:17, II:10), with no previous treatments at the hips and knees, underwent EOS® biplanar X-rays. A control group consisting of 22 typically developing children was also included. Three-dimensional reconstructions of the pelvis and lower limbs were performed in order to calculate 11 radiological parameters related to the pelvis, acetabulum and lower limbs. Pelvic incidence and sacral slope were significantly increased in children with CP compared to TD children ($48\pm 7^\circ$ vs. $43\pm 8^\circ$, $42\pm 7^\circ$ vs. $38\pm 5^\circ$, respectively, $p=0.003$). Acetabular parameters did not significantly differ between the two groups. Femoral anteversion and neck shaft angle were significantly increased in children with CP ($25\pm 12^\circ$ vs. $14\pm 7^\circ$, $p<0.001$; $134\pm 5^\circ$ vs. $131\pm 5^\circ$, $p=0.005$ respectively). No difference was found for

tibial torsion. This study showed that even slightly impaired children with CP have an anteverted and abducted femur and present positional and morphological changes of the pelvis in the sagittal plane. The orientation of the acetabulum in 3D seems to not be affected when children with CP present slight motor impairment.

[PMID: 27395450](#)

3. Res Dev Disabil. 2016 Jul 8;57:102-111. doi: 10.1016/j.ridd.2016.06.010. [Epub ahead of print]

Motor imagery difficulties in children with Cerebral Palsy: A specific or general deficit?

Lust JM, Wilson PH, Steenbergen B.

AIM: The aim of this study was to examine the specificity of motor imagery (MI) difficulties in children with CP. METHOD: Performance of 22 children with CP was compared to a gender and age matched control group. MI ability was measured with the Hand Laterality Judgment (HLJ) task, examining specifically the direction of rotation (DOR) effect, and the Praxis Imagery Questionnaire (PIQ). RESULTS: In the back view condition of the HLJ task both groups used MI, as evidenced by longer response times for lateral compared with medial rotational angles. In the palm view condition children with CP did not show an effect of DOR, unlike controls. Error scores did not differ between groups. Both groups performed well on the PIQ, with no significant difference between them in response pattern. CONCLUSION AND IMPLICATION: The present study suggests that children with CP show deficits on tasks that trigger implicit use of MI, whereas explicit MI ability was relatively preserved, as assessed using the PIQ. These results suggest that employing more explicit methods of MI training may well be more suitable for children with CP in rehabilitation of motor function.

[PMID: 27399206](#)

4. Res Dev Disabil. 2016 Jul 8;57:92-101. doi: 10.1016/j.ridd.2016.06.017. [Epub ahead of print]

Effects of severity of gross motor disability on anticipatory postural adjustments while standing in individuals with bilateral spastic cerebral palsy.

Tomita H, Fukaya Y, Takagi Y, Yokozawa A.

BACKGROUND: Although individuals with bilateral spastic cerebral palsy (BSCP) exhibit several deficits in anticipatory postural adjustments (APAs) while standing, effects of severity of motor disability on their APAs are unclear. AIMS: To determine whether individuals with BSCP exhibit severity-dependent deficits in APAs. METHODS AND PROCEDURES: Seven individuals with level II BSCP (BSCP-II group) and seven with level III BSCP (BSCP-III group) according to the Gross Motor Function Classification System and seven healthy controls lifted a load under two different load conditions. OUTCOMES AND RESULTS: Anticipatory activities of the erector spinae (ES), medial hamstring (MH), and gastrocnemius (GCM) were smaller in the two BSCP groups than in the control group. Although the anticipatory GCM activity was similar between the BSCP groups, the ES and MH activities were larger in the BSCP-II group than in the BSCP-III group. In the BSCP-II group, an increase in anticipatory activity with an increase in load was observed in the MH, but not in the GCM. In the BSCP-III group, load-related modulation was not found in the MH or GCM. CONCLUSIONS AND IMPLICATIONS: The present findings suggest that in individuals with BSCP with severe motor disability, APA deficits extend to more proximal parts of the body.

[PMID: 27399205](#)

5. Res Dev Disabil. 2016 Jul 7;57:85-91. doi: 10.1016/j.ridd.2016.06.006. [Epub ahead of print]

Impact of loaded sit-to-stand exercises at different speeds on the physiological cost of walking in children with spastic diplegia: A single-blind randomized clinical trial.

Kusumoto Y, Nitta O, Takaki K.

PURPOSE: In the present study, we aimed to determine whether similarly loaded sit-to-stand exercises at different speeds improve the physiological cost of walking in children with spastic diplegia. METHODS: This design was a single-blind

randomized clinical trial. Sixteen children with cerebral palsy (CP), aged 12-18 years, with a diagnosis of spastic diplegia, were randomly allocated to a slow loaded sit-to-stand exercise group (n=8) and a self-paced loaded sit-to-stand exercise group (n=8). Loaded sit-to-stand exercise was conducted at home for 15min, 4 sets per day, 3-4days per week, for 6 weeks. The patients were evaluated immediately before the intervention and after the training. Lower limb muscle strength using a hand-held dynamometer, selective voluntary motor control using SCALE, 6-min walk distance (6MWD), and Physiological Cost Index (PCI) were measured. RESULTS: The 6MWD showed a significant difference before and after intervention. PCI showed a significant difference between the two groups and the two time points. 6MWD and the PCI improved after intervention in the slow sit-to-stand exercise group. CONCLUSIONS: Compared to loaded sit-to-stand exercise at a regular speed, slow low-loaded sit-to-stand exercise improved the 6MWD and PCI in children with CP, suggesting that this decrease in speed during exercise improves the physiological cost of walking in these children.

[PMID: 27394691](#)

6. Acta Bioeng Biomech. 2016;18(2):121-9.

Research of the spatial-temporal gait parameters and pressure characteristic in spastic diplegia children.

Pauk J, Ihnatouski M, Daunoraviciene K, Laskhousky U, Griskevicius J.

PURPOSE: Spastic diplegia is the most common form of cerebral palsy. It presents with symmetric involvement of the lower limbs and upper limbs. Children with spastic diplegia frequently experience problems with motor control, spasticity, and balance which lead to gait abnormalities. The aim of this study is twofold. Firstly, to determine the differences in spatial-temporal gait parameters and magnitude of plantar pressure distribution between children with spastic diplegia (CP) and typical children. Secondly, to compare and evaluate main changes of plantar pressure and spatial-temporal gait parameters instead of data between spastic diplegia children with prescribed ankle - solid foot orthosis (AFOs) and without using AFOs. METHODS: The evaluation was carried out on 20 spastic diplegia children and 10 age-matched children as a control group aged 6-15 years. Twenty children with spastic diplegia CP were divided into two groups: ten subjects with prescribed AFOs and ten subjects without use of assistive device. Patients used the AFOs orthosis for one year. Measurements included in-shoe plantar pressure distribution and spatial-temporal gait parameters. RESULTS: Spatial-temporal gait parameters showed meaningful difference between study groups in velocity, stride length, step length and cadence ($p < 0.05$). However no significant differences between patients with and without AFOs were found ($p > 0.05$). Significant differences between typical and spastic diplegia children with AFOs were observed in the magnitude of plantar pressure under the toes, the metatarsal heads, the medial arch, and the heel ($p < 0.05$). For typical subjects, the highest pressure amplitudes were found under the heel and the metatarsal heads, while the lowest pressure distribution was under the medial arch. In CP patients the lateral arch was strongly unloaded. The peak pressure under heel was shifted inside. CONCLUSIONS: Collected data and calculated scores present a state of the gait in test groups, showed the difference and could be valuable for physicians in decision making by choosing qualitative therapy. Furthermore, it allows predicting probability of further possible changes in gait of spastic diplegia patients with AFOs and without it. In conclusion, our current results showed that the use of AFOs, prescribed on a clinical basis by doctors improves gait patterns and gait stability in children with spastic cerebral palsy.

[PMID: 27405783](#)

7. Acta Bioeng Biomech. 2016;18(2):3-7.

Could lower leg Wartenberg test be used as a predictor of restrictions in temporomandibular joint movements in CP patients?

Syczewska M, Szczerbik E, Graff K, Olczak-Kowalczyk D, Dąbrowska-Gontarczyk A, Kalinowska M, Jelonek E.

PURPOSE: Patients with spasticity suffer not only from neurological problems but also from various dentistry problems due to spasticity of the jaw muscles. Measurements of motion in temporomandibular joints should reflect the amount of abnormal muscle tone of these muscles. The aim of this study was to find out if the measurements of temporomandibular joint movements performed with the ultrasound Zebris device are different in cerebral palsy patients than in healthy subjects; and to find out if the information on the degree of spasticity in the lower legs provided by the Wartenberg test could be used to predict the degree of spasticity in the jaw muscles. METHOD: Twenty five healthy subjects and 25 cerebral palsy patients participated in the study. Two types of measurements were performed: temporomandibular movements measured with Zebris device, and instrumented Wartenberg test. RESULTS: The laterotrusion and opening movements are different in CP patients than in healthy subjects. Laterotrusion movement correlates with velocity measured during the Wartenberg test. CONCLUSION: This

finding suggests that high spasticity in the lower legs could indicate jaw movement restrictions in CP patients.

[PMID: 27405291](#)

8. Indian J Pediatr. 2016 Jul 9. [Epub ahead of print]

Joubert Syndrome Mimicking Hypotonic Cerebral Palsy.

Kumar S, Singh D.

[No abstract available]

[PMID: 27392618](#)

9. Indian Pediatr. 2016 Jun 1. pii: S097475591600011. [Epub ahead of print]

Application of the International Classification of Functioning, Disability and Health - Children and Youth in Children With Cerebral Palsy.

Jeevanantham D.

The International Classification of Functioning, Disability and Health (ICF) is a framework for describing health status; however, there is a gap in literature for supporting its use as a classification tool. The purpose of this paper is to provide a perspective on its use in describing children with cerebral palsy. The interconnected concepts of the ICF are more important than the classification elements itself. Further research is required to prove its use as a classification tool in clinical practice.

[PMID: 27395840](#)

10. Paediatr Child Health. 2016 Apr;21(3):129-30.

A plea for developmental motor screening in Canadian infants.

Harris SR.

Motor delays during infancy may be the first observable sign of a specific neurodevelopmental disability or of more global developmental delays. The earlier such disorders are identified, the sooner these infants can be referred for early intervention services. Although developmental motor screening is strongly recommended in other Western countries, Canada has yet to provide a developmental surveillance and screening program. Ideally, screening for motor disabilities should occur as part of the 12-month well-baby visit. In advance of that visit, parents can be provided with a parent-screening questionnaire that they can complete and bring with them to their 12-month office visit. Interpretation of the parent-completed questionnaire takes only 2 min to 3 min of the health care professional's time and, based on the results, can either reassure parents that their infant is developing typically, or lead to a referral for standardized motor screening or assessment by a paediatric physical or occupational therapist.

[PMID: 27396842](#)

11. Percept Mot Skills. 2016 Feb;122(1):150-64. doi: 10.1177/0031512515625388. Epub 2016 Feb 1.

Reliability and Validity of The Cerebral Palsy Quality of Life Questionnaire in The Turkish Population.

Atsavun Uysal S, Düger T, Elbasan B, Karabulut E, Toyulan İ.

This study examined the psychometric properties of the Turkish version of the Cerebral Palsy Quality of Life Questionnaire (CP QOL). A total of 149 primary caregivers completed the final version of the CP QOL-Primary Caregivers and the Children4

Health Questionnaire (CHQ) for children 4-12 years old (M age = 7.6 yr., SD = 2.5); 58 children with CP ages 9 to 12 years completed the CP QOL-Child and Health-Related Quality of Life Questionnaire for Children (Kid-KINDL) questionnaire. The Gross Motor Function Classification System was also used for the classification of the children with CP. Internal consistency (Cronbach's α) ranged between .63 and .93 for primary caregivers and .61 to .92 for the children's self-reports. Intra-class correlation coefficients ranged between .88 and .97 for primary caregivers and .91 to .98 for children. It was concluded that the Turkish version of CP QOL questionnaire is a reliable and valid tool for assessing QOL in children with CP.

[PMID: 27420313](#)

12. Syst Rev. 2016 Jul 13;5(1):112. doi: 10.1186/s13643-016-0287-4.

A critical evaluation of the effectiveness of interventions for improving the well-being of caregivers of children with cerebral palsy: a systematic review protocol.

Dambi JM, Jelsma J, Mlambo T, Chikwanha MT, Corten L.

BACKGROUND: Over the years, family-centered care has evolved as the "gold standard" model for the provision of healthcare services. With the advent of family-centered approach to care comes the inherent need to provide support services to caregivers in addition to meeting the functional needs of children with physical disabilities such as cerebral palsy (CP). Provision of care for a child with CP is invariably associated with poor health outcomes in caregivers. As such, there has been a surge in the development and implementation of interventions for improving the health and well-being of these caregivers. However, there is a paucity of the collective, empirical evidence of the efficacy of these interventions. Therefore, the broad objective of this review is to systematically review the literature on the effectiveness of interventions designed to improve caregivers' well-being. **METHODS/DESIGN:** This is a systematic review for the evaluation of the effectiveness of interventions designed to improve caregivers' well-being. Two independent, blinded, reviewers will search articles on PubMed, Scopus, Web of Science, CINAHL, Psych Info, and Africa-Wide Information using a predefined criterion. Thereafter, three independent reviewers will screen the retrieved articles. The methodological quality of studies meeting the selection criterion will be evaluated using the Briggs Institute checklists. Afterwards, two independent researchers will then apply a preset data-extraction form to collect data. We will perform a narrative data analysis of the final sample of studies included for the review. **DISCUSSION:** The proposed systematic review will provide the empirical evidence of the efficacy of interventions for improving the well-being of caregivers of children with physical disabilities. This is important given the great need for evidenced-based care and the greater need to improve the health and well-being of caregivers.

[PMID: 27412135](#)

13. J Clin Exp Dent. 2016 Jul 1;8(3):e337-43. doi: 10.4317/jced.52922. eCollection 2016.

Oral health in children with physical (Cerebral Palsy) and intellectual (Down Syndrome) disabilities: Systematic review I.

Diéguez-Pérez M, de Nova-García MJ, Mourelle-Martínez MR, Bartolomé-Villar B.

INTRODUCTION: Traditionally, patients with physical and/or intellectual disabilities presented greater oral pathology, owing to their condition and to other external factors. Improved social and health conditions make it necessary to update knowledge on their oral and dental health. **MATERIAL AND METHODS:** For this purpose, a bibliographic review was done regarding the state of oral health of children with these two types of disability, in comparison with a control group. Some of the guidelines of the PRISMA statement were taken into account. The ranking of the articles found is based on the modified Newcastle-Ottawa Quality Assessment Scale. The final number of articles evaluated was 14. Parameters such as dental caries, oral hygiene, gingival health, dental traumas, malocclusion and habits were considered. **RESULTS:** There is no consensus among authors regarding dental caries, oral hygiene and gingival health. The different results obtained are due in part to the fact that the methodologies used were not the same. However, it has been noted that, when studying other parameters and regardless of the methodology employed, the results obtained are similar. **CONCLUSIONS:** Children with physical and intellectual disabilities constitute a group that needs early and regular dental care in order to prevent and limit the severity of the pathologies observed.

[PMID: 27398187](#)

14. Comput Intell Neurosci. 2016;2016:8984379. doi: 10.1155/2016/8984379. Epub 2016 Jun 14.

Novel Virtual Environment for Alternative Treatment of Children with Cerebral Palsy.

de Oliveira JM, Fernandes RC, Pinto CS, Pinheiro PR, Ribeiro S, de Albuquerque VH.

Cerebral palsy is a severe condition usually caused by decreased brain oxygenation during pregnancy, at birth or soon after birth. Conventional treatments for cerebral palsy are often tiresome and expensive, leading patients to quit treatment. In this paper, we describe a virtual environment for patients to engage in a playful therapeutic game for neuropsychomotor rehabilitation, based on the experience of the occupational therapy program of the Nucleus for Integrated Medical Assistance (NAMI) at the University of Fortaleza, Brazil. Integration between patient and virtual environment occurs through the hand motion sensor "Leap Motion," plus the electroencephalographic sensor "MindWave," responsible for measuring attention levels during task execution. To evaluate the virtual environment, eight clinical experts on cerebral palsy were subjected to a questionnaire regarding the potential of the experimental virtual environment to promote cognitive and motor rehabilitation, as well as the potential of the treatment to enhance risks and/or negatively influence the patient's development. Based on the very positive appraisal of the experts, we propose that the experimental virtual environment is a promising alternative tool for the rehabilitation of children with cerebral palsy.

[PMID: 27403154](#)

15. Appl Res Qual Life. 2016;11:571-599. Epub 2015 Jan 7.

Quality of Life and Self-Determination: Youth with Chronic Health Conditions Make the Connection.

McDougall J, Baldwin P, Evans J, Nichols M, Etherington N, Wright V.

While optimizing quality of life (QOL) is a key goal of rehabilitation care, no previous study has reported on what 'QOL' means to youth with chronic health conditions. In addition, no qualitative studies have explored the relationship between QOL and self-determination (SD). Objectives of this qualitative study were to examine: what the terms 'quality of life' and 'self-determination' mean to youth with chronic conditions; the factors these youth think are linked with these concepts; the relationship they see between concepts, the types of future goals youth have and how they view the connection between their SD and these goals. A descriptive methodology was used. A purposive sample of 15 youth aged 15 to 20 years was obtained. Youth had cerebral palsy, a central nervous system disorder, or autism spectrum disorder. Semi-structured interviews were conducted first, followed by a focus group. Line-by-line coding of transcripts was completed, codes were collapsed into categories, and themes identified. Participants viewed QOL as an overarching personal evaluation of their life, and used terms such as satisfaction and happiness to describe the concept. Factors related to QOL included: 'relationships', 'supportive environments', 'doing things', 'personal growth and moving forward', and 'understanding of self/acceptance of disability'. Participants described SD in such terms as confidence and motivation. Contributors to SD were: 'personal strengths', 'interdependence', and 'functional independence'. SD was considered important to QOL. Youth goals were reflective of the goals of most adolescents. They identified the importance of having key goals that were of personal interest to them. This study adds consumer-based information to the debate over the meaning of QOL. Service providers and decision makers should be aware of the factors that youth feel impact their QOL and SD, the importance of SD to youth QOL, and of SD to future goals, and consider this information when tailoring therapeutic interventions.

[PMID: 27398103](#)

Prevention and Cure

16. *Am J Perinatol.* 2016 Jul 11. [Epub ahead of print]

Does Infection During Pregnancy Outside of the Time of Delivery Increase the Risk of Cerebral Palsy?

Brookfield KF, Osmundson SS, Caughey AB, Snowden JM.

Objective We sought to evaluate whether maternal antepartum infection (excluding chorioamnionitis) is associated with cerebral palsy (CP). **Study Design** This is a secondary analysis from a multicenter trial in women at risk of preterm delivery who received antenatal magnesium sulfate versus placebo. We compared the risk of CP in the children of women who had evidence of antepartum infection over the course of pregnancy to those women who had no evidence of antepartum infection during pregnancy. **Results** Within a cohort of 2,251 women who met our inclusion criteria, 1,350 women had no history of infection in pregnancy and 801 women had a history of some type of antepartum infection during pregnancy. The incidence of CP was similar between the two groups (4.9 vs 5.0%; $p = 0.917$). After adjustment for maternal and obstetric confounders, we observed no significantly increased risk of CP among infants born to women with evidence of antepartum infection; (adjusted relative risk [aRR], 1.09 (0.72, 1.66); $p = 0.68$). **Conclusion** Compared with women with no evidence of antepartum infection during pregnancy, those women with infections excluding chorioamnionitis may not be at an increased risk of delivering an infant with CP.

[PMID: 27398702](#)

17. *Cochrane Database Syst Rev.* 2016 Jul 12;7:CD008968. [Epub ahead of print]

Immediate versus deferred delivery of the preterm baby with suspected fetal compromise for improving outcomes.

Stock SJ, Bricker L, Norman JE, West HM.

BACKGROUND: Immediate delivery of the preterm fetus with suspected compromise may decrease the risk of damage due to intrauterine hypoxia. However, it may also increase the risks of prematurity. **OBJECTIVES:** To assess the effects of immediate versus deferred delivery of preterm babies with suspected fetal compromise on neonatal, maternal and long-term outcomes. **SEARCH METHODS:** We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (30 April 2016) and reference lists of retrieved studies. **SELECTION CRITERIA:** Randomised trials comparing a policy of immediate delivery with deferred delivery or expectant management in preterm fetuses with suspected in utero compromise. Quasi-randomised trials and trials employing a cluster-randomised design were eligible for inclusion but none were identified. **DATA COLLECTION AND ANALYSIS:** Two review authors independently assessed trials for inclusion and risk of bias, extracted data and checked them for accuracy. **MAIN RESULTS:** We included one trial of 548 women (588 babies) in the review. Women with pregnancies between 24 and 36 weeks' gestation took part. The study took place in 13 European countries, between 1993 and 2001. The difference in the median randomisation to delivery interval between immediate delivery and deferred delivery was four days (median: 0.9 (inter-quartile range (IQR) 0.4 to 1.3) days for immediate delivery, median: 4.9 (IQR 2.0 to 10.8) days in the delay group). There was no clear difference in the primary outcomes of extended perinatal mortality (risk ratio (RR) 1.17, 95% confidence interval (CI) 0.67 to 2.04, one trial, 587 babies, moderate-quality evidence) or the composite outcome of death or disability at or after two years of age (RR 1.22, 95% CI 0.85 to 1.75, one trial, 573 babies, moderate-quality evidence) with immediate delivery compared to deferred delivery. The results for these outcomes are consistent with both appreciable benefit and harm. More babies in the immediate delivery group were ventilated for more than 24 hours (RR 1.54, 95% CI 1.20 to 1.97, one trial, 576 babies). There were no differences between the immediate delivery and deferred delivery groups in any other infant mortality outcome (stillbirth, neonatal mortality, postneonatal mortality > 28 days to discharge), individual neonatal morbidity or markers of neonatal morbidity (cord pH less than 7.00, Apgar less than seven at five minutes, convulsions, interventricular haemorrhage or germinal matrix haemorrhage, necrotising enterocolitis and periventricular leucomalacia or ventriculomegaly). Some important outcomes were not reported, in particular infant admission to neonatal intensive care or special care facility, and respiratory distress syndrome. We were not able to calculate composite rates of serious neonatal morbidity, even though individual morbidities were reported, due to the risk of double counting infants with more than one morbidity. More children in the immediate delivery group had cerebral palsy at or after two years of age (RR 5.88, 95% CI 1.33 to 26.02, one trial, 507 children). There were, however, no differences in neurodevelopment impairment at or after two years (RR 1.72, 95% CI 0.86 to 3.41, one trial, 507 children), death at or after two years of age (RR 1.04, 95% CI 0.66 to 1.63, one trial, 573 children), or death or disability in childhood (six to 13 years of age) (RR 0.82, 95% CI 0.48 to 1.40, one trial, 302 children). More women in the immediate delivery group had caesarean delivery than in the deferred delivery group (RR 1.15, 95% CI 1.07 to 1.24, one trial, 547 women, high-quality evidence). Data were not available on any other maternal outcomes. There were several methodological weaknesses in the included study, and the level of evidence for the primary outcomes was graded high for caesarean section and moderate for extended perinatal mortality and death or disability at or

after two years. The evidence was downgraded because the CIs for these outcomes were wide, and were consistent with both appreciable benefit and harm. Bias may have been introduced by several factors: blinding was not possible due to the nature of the intervention, data for childhood follow-up were incomplete due to attrition, and no adjustment was made in the analysis for the non-independence of babies from multiple pregnancies (39 out of 548 pregnancies). This study only included cases of suspected fetal compromise where there was uncertainty whether immediate delivery was indicated, thus results must be interpreted with caution. **AUTHORS' CONCLUSIONS:** Currently there is insufficient evidence on the benefits and harms of immediate delivery compared with deferred delivery in cases of suspected fetal compromise at preterm gestations to make firm recommendations. There is a lack of trials addressing this question, and limitations of the one included trial means that caution must be used in interpreting and generalising the findings. More research is needed to guide clinical practice. Although the included trial is relatively large, it has insufficient power to detect differences in neonatal mortality. It did not report any maternal outcomes other than mode of delivery, or evaluate maternal satisfaction or economic outcomes. The applicability of the findings is limited by several factors: Women with a wide range of obstetric complications and gestational ages were included, and subgroup analysis is currently limited. Advances in Doppler assessment techniques may diagnose severe compromise more accurately and help make decisions about the timing of delivery. The potential benefits of deferring delivery for longer or shorter periods cannot be presumed. Where there is uncertainty whether or not to deliver a preterm fetus with suspected fetal compromise, there seems to be no benefit to immediate delivery. Deferring delivery until test results worsen or increasing gestation favours delivery may improve the outcomes for mother and baby. There is a need for high-quality randomised controlled trials comparing immediate and deferred delivery where there is suspected fetal compromise at preterm gestations to guide clinical practice. Future trials should report all important outcomes, and should be adequately powered to detect differences in maternal and neonatal morbidity and mortality.

[PMID: 27404120](#)