

Monday 25 March 2013

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Interventions and Management

1. *Dev Med Child Neurol.* 2013 Mar 20. doi: 10.1111/dmcn.12124. [Epub ahead of print]

Passive muscle properties are altered in children with cerebral palsy before the age of 3 years and are difficult to distinguish clinically from spasticity.

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AIM: Clinical determination of spasticity is confounded by the difficulty in distinguishing reflex from passive contributions to muscle stiffness. There is, therefore, a risk that children with cerebral palsy (CP) receive antispasticity treatment unnecessarily. To investigate this, we aimed to determine the contribution of reflex mechanisms to changes in the passive elastic properties of muscles and tendons in children with CP. **METHOD:** Biomechanical and electrophysiological measures were used to determine the relative contribution of reflex and passive mechanisms to ankle muscle stiffness in 35 children with spastic CP (21 males, 14 females; mean age 9y, SD 3y 4mo; range 3-15y) and 28 control children without CP (19 males, nine females; mean age 8y 11mo, SD 2y 10mo; range 3-15y). Twenty-seven children were diagnosed as having spastic hemiplegia, six with spastic diplegia, and two with spastic tetraplegia. According to the Gross Motor Function Classification System, 31 children were classified in level I, two in level II, and two in level III. **RESULTS:** Only seven children with spastic CP showed reflex stiffness outside the range of the control children. In contrast, 20 children with spastic CP showed abnormal passive muscle stiffness ($p < 0.001$). No correlation between increased reflex or increased passive muscle stiffness and age was observed within the age range studied. **INTERPRETATION:** These data suggest that increased reflex-mediated muscle stiffness is difficult to distinguish clinically from changes in passive muscle stiffness and that signs of changes in muscle properties are already present from the age of 3 years in children with CP. This emphasizes the importance of accurately distinguishing different contributions to muscle stiffness to avoid unnecessary antispasticity treatment.

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[PMID: 23517272](https://pubmed.ncbi.nlm.nih.gov/23517272/) [PubMed - as supplied by publisher]

2. Res Dev Disabil. 2013 Mar 12;34(5):1731-1739. doi: 10.1016/j.ridd.2013.02.003. [Epub ahead of print]

Structural equation modeling of motor impairment, gross motor function, and the functional outcome in children with cerebral palsy.

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Physical therapy intervention for children with cerebral palsy (CP) is focused on reducing neurological impairments, improving strength, and preventing the development of secondary impairments in order to improve functional outcomes. However, relationship between motor impairments and functional outcome has not been proved definitely. This study confirmed the construct of motor impairment and performed structural equation modeling (SEM) between motor impairment, gross motor function, and functional outcomes of regarding activities of daily living in children with CP. 98 children (59 boys, 39 girls) with CP participated in this cross-sectional study. Mean age was 11y 5mo (SD 1y 9mo). The Manual Muscle Test (MMT), the Modified Ashworth Scale (MAS), range of motion (ROM) measurement, and the selective motor control (SMC) scale were used to assess motor impairments. Gross motor function and functional outcomes were measured using the Gross Motor Function Measure (GMFM) and the Functional Skills domain of the Pediatric Evaluation of Disability Inventory (PEDI) respectively. Measurement of motor impairment was consisted of strength, spasticity, ROM, and SMC. The construct of motor impairment was confirmed though an examination of a measurement model. The proposed SEM model showed good fit indices. Motor impairment effected gross motor function ($\beta=-.0869$). Gross motor function and motor impairment affected functional outcomes directly ($\beta=0.890$) and indirectly ($\beta=-0.773$) respectively. We confirmed that the construct of motor impairment consist of strength, spasticity, ROM, and SMC and it was identified through measurement model analysis. Functional outcomes are best predicted by gross motor function and motor impairments have indirect effects on functional outcomes.

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[PMID: 23500167](#) [PubMed - as supplied by publisher]

3. Res Dev Disabil. 2013 Mar 11;34(5):1689-1699. doi: 10.1016/j.ridd.2013.02.011. [Epub ahead of print]

Gait stability in children with Cerebral Palsy.

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Children with unilateral Cerebral Palsy (CP) have several gait impairments, amongst which impaired gait stability may be one. We tested whether a newly developed stability measure (the foot placement estimator, FPE) which does not require long data series, can be used to asses gait stability in typically developing (TD) children as well as children with CP. In doing so, we tested the FPE's sensitivity to the assumptions needed to calculate this measure, as well as the ability of the FPE to detect differences in stability between children with CP and TD children, and differences in walking speed. Participants were asked to walk at two different speeds, while gait kinematics were recorded. From these data, the FPE, as well as the error that violations of assumptions of the FPE could have caused were calculated. The results showed that children with CP walked with marked instabilities in anterior-posterior and mediolateral directions. Furthermore, errors caused by violations of assumptions in calculation of FPE were only small (~1.5cm), while effects of walking speed (~20cm per m/s increase in walking speed) and group (~5cm) were much larger. These results suggest that the FPE may be used to quantify gait stability in TD children and children with CP.

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4. Clin Rehabil. 2013 Mar 15. [Epub ahead of print]**A comparison of treadmill training and overground walking in ambulant children with cerebral palsy: randomized controlled clinical trial.**

Grecco LA, Zanon N, Sampaio LM, Oliveira CS.

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Objective: Compare the effects of treadmill training and training with overground walking (both without partial weight support) on motor skills in children with cerebral palsy. **Design:** Randomized controlled clinical trial. **Setting:** Physical therapy clinics. **Subjects:** Thirty-six children with cerebral palsy (levels I-III of the Gross Motor Functional Classification System) randomly divided into two intervention groups. **Interventions:** Experimental group (17 children) submitted to treadmill training without partial weight support. Overground walking group (18 children) submitted to gait training on a fixed surface (ground). Training was performed for seven consecutive weeks (two sessions per week), with four subsequent weeks of follow-up. **Results:** Both groups demonstrated improvements on the 6-minute walk test (experimental group from 227.4 SD 49.4 to 377.2 SD 93.0; overground walking group from 222.6 SD 42.6 to 268.0 SD 45.0), timed up-and-go test (experimental group from 14.3 SD 2.9 to 7.8 SD 2.2; overground walking group from 12.8 SD 2.2 to 10.5 SD 2.5), Pediatric Evaluation Disability Inventory (experimental group from 128.0 SD 19.9 to 139.0 SD 18.4; overground walking group from 120.8 SD 19.0 to 125.8 SD 12.2), Gross Motor Function Measure-88 (experimental group from 81.6 SD 8.7 to 93.0 SD 5.7; overground walking group from 77.3 SD 7.0 to 80.8 SD 7.2), Berg Balance Scale (experimental group from 34.9 SD 8.5 to 46.7 SD 7.6; overground walking group from 31.9 SD 7.0 to 35.7 SD 6.8) after treatment. The experimental group demonstrated greater improvements than the overground walking group both after treatment and during follow up ($p < 0.05$). **Conclusion:** Treadmill training proved more effective than training with overground walking regarding functional mobility, functional performance, gross motor function and functional balance in children with cerebral palsy.

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5. J Neuroeng Rehabil. 2013 Mar 21;10(1):30. [Epub ahead of print]**Effectiveness of robot-assisted therapy on ankle rehabilitation -- a systematic review.**

Zhang M, Davies TC, Xie S.

OBJECTIVE: The aim of this study was to provide a systematic review of studies that investigated the effectiveness of robot-assisted therapy on ankle motor and function recovery from musculoskeletal or neurologic ankle injuries. **METHODS:** Thirteen electronic databases of articles published from January, 1980 to June, 2012 were searched using keywords 'ankle*', 'robot*', 'rehabilitat*' or 'treat*' and a free search in Google Scholar based on effects of ankle rehabilitation robots was also conducted. References listed in relevant publications were further screened. Eventually, twenty-nine articles were selected for review and they focused on effects of robot-assisted ankle rehabilitation. **RESULTS:** Twenty-nine studies met the inclusion criteria and a total of 164 patients and 24 healthy subjects participated in these trials. Ankle performance and gait function were the main outcome measures used to assess the therapeutic effects of robot-assisted ankle rehabilitation. The protocols and therapy treatments were varied, which made comparison among different studies difficult or impossible. Few comparative trials were conducted among different devices or control strategies. Moreover, the majority of study designs met levels of evidence that were no higher than American Academy for Cerebral Palsy (CP) and Developmental Medicine (AAPDM) level IV. Only one study used a Randomized Control Trial (RCT) approach with the evidence level being II. **CONCLUSION:** All the selected studies showed improvements in terms of ankle performance or gait function after a period of robot-assisted ankle rehabilitation training. The most effective robot-assisted intervention cannot be determined due to the lack of universal evaluation criteria for various devices and control strategies. Future research into the effects of robot-assisted ankle rehabilitation should be carried out based on universal evaluation criteria, which could determine the most effective method of intervention. It is also essential to conduct trials to analyse the differences among different devices or control strategies.

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6. Zhongguo Dang Dai Er Ke Za Zhi. 2013 Mar;15(3):187-791.**Effect of infra-low-frequency transcranial magnetic stimulation on motor function in children with spastic cerebral palsy [Article in Chinese]**

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OBJECTIVE: To study the therapeutic effects of infra-low-frequency transcranial magnetic stimulation in children with spastic cerebral palsy. **METHODS:** Seventy-five children with spastic cerebral palsy were randomly divided into two groups: control (n=33) and treatment groups (n=42). The treatment group accepted infra-low-frequency transcranial magnetic stimulation besides conventional comprehensive rehabilitation therapy. The control group only accepted conventional comprehensive rehabilitation therapy. Motor functions were assessed by gross motor function measure (GMFM) and fine motor function measure (FMFM) at one and three months after treatment. **RESULTS:** Improvement in the ability to sit in the treatment was better than in the control group at one month after treatment ($P<0.05$). Improvement in the ability to sit, crawl and kneel, total score of GMFM, and improvement of joint active ability of limbs, grasping ability and operating ability in the treatment group were better than the control group at three months after treatment ($P<0.05$). **CONCLUSIONS:** Infra-low-frequency transcranial magnetic stimulation can effectively improve motor function in children with spastic cerebral palsy.

[PMID: 23498759](#) [PubMed - in process]**7. Res Dev Disabil. 2013 Mar 8;34(5):1678-1688. doi: 10.1016/j.ridd.2013.01.035. [Epub ahead of print]****Brain structure and executive functions in children with cerebral palsy: A systematic review.**

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This systematic review aimed to establish the current knowledge about brain structure and executive function (EF) in children with cerebral palsy (CP). Five databases were searched (up till July 2012). Six articles met the inclusion criteria, all included structural brain imaging though no functional brain imaging. Study quality was assessed using the STROBE checklist. All articles scored between 58.7% and 70.5% for quality (100% is the maximum score). The included studies all reported poorer performance on EF tasks for children with CP compared to children without CP. For the selected EF measures non-significant effect sizes were found for the CP group compared to a semi-control group (children without cognitive deficits but not included in a control group). This could be due to the small sample sizes, group heterogeneity and lack of comparison of the CP group to typically developing children. The included studies did not consider specific brain areas associated with EF performance. To conclude, there is a paucity of brain imaging studies focused on EF in children with CP, especially of studies that include functional brain imaging. Outcomes of the present studies are difficult to compare as each study included different EF measures and cortical abnormality measures.

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[PMID: 23500162](#) [PubMed - as supplied by publisher]**8. Res Dev Disabil. 2013 Mar 7;34(5):1710-1720. doi: 10.1016/j.ridd.2013.02.017. [Epub ahead of print]****Does somatosensory discrimination activate different brain areas in children with unilateral cerebral palsy compared to typically developing children? An fMRI study.**

Van de Winckel A, Verheyden G, Wenderoth N, Peeters R, Sunaert S, Van Hecke W, De Cock P, Desloovere K, Eyssen M, Feys H.

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Aside from motor impairment, many children with unilateral cerebral palsy (CP) experience altered tactile, proprioceptive, and kinesthetic awareness. Sensory deficits are addressed in rehabilitation programs, which include somatosensory discrimination exercises. In contrast to adult stroke patients, data on brain activation, occurring during somatosensory discrimination exercises, are lacking in CP children. Therefore, this study investigated brain activation with functional magnetic resonance imaging (fMRI) during passively guided somatosensory discrimination exercises in 18 typically developing children (TD) (age, $M=14\pm 1.92$ years; 11 girls) and 16 CP children (age, $M=15\pm 2.54$ years; 8 girls). The demographic variables between both groups were not statistically different. An fMRI compatible robot guided the right index finger and performed pairs of unfamiliar geometric shapes in the air, which were judged on their equality. The control condition comprised discrimination of music fragments. Both groups exhibited significant activation (FDR, $p<.05$) in frontoparietal, temporal, cerebellar areas, and insula, similar to studies in adults. The frontal areas encompassed ventral premotor areas, left postcentral gyrus, and precentral gyrus; additional supplementary motor area (SMAproper) activation in TD; as well as dorsal premotor, and parietal operculum recruitment in CP. On uncorrected level, $p<.001$, TD children revealed more left frontal lobe, and right cerebellum activation, compared to CP children. Conversely, CP children activated the left dorsal cingulate gyrus to a greater extent than TD children. These data provide incentives to investigate the effect of somatosensory discrimination during rehabilitation in CP, on clinical outcome and brain plasticity.

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[PMID: 23500165](#) [PubMed - as supplied by publisher]

9. Anesth Prog. 2013 Spring;60(1):11-4. doi: 10.2344/11-00031.1.

Ventilation via Cut Nasotracheal Tube During General Anesthesia.

Asahi Y, Omichi S, Adachi S, Kagamiuchi H, Kotani J.

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Many patients with disabilities need recurrent dental treatment under general anesthesia because of high caries prevalence and the nature of dental treatment. We evaluated the use of a nasal device as a possible substitute for flexible laryngeal mask airway to reduce the risk of unexpected failure accompanying intubation; we succeeded in ventilating the lungs with a cut nasotracheal tube (CNT) with its tip placed in the pharynx. We hypothesized that this technique would be useful during dental treatment under general anesthesia and investigated its usefulness as part of a minimally invasive technique. A prospective study was designed using general anesthesia in 37 dental patients with disabilities such as intellectual impairment, autism, and cerebral palsy. CNT ventilation was compared with mask ventilation with the patient in 3 positions: the neck in flexion, horizontal position, and in extension. The effect of mouth gags was also recorded during CNT ventilation. The percentages of cases with effective ventilation were similar for the 2 techniques in the neck extension and horizontal positions (89.2-97.3%). However, CNT ventilation was significantly more effective than mask ventilation in the neck flexion position (94.6 vs 45.9%; $P < .0001$). Mouth gags slightly reduced the rate of effective ventilation in the neck flexion position. Most dental treatments involving minor oral surgeries were performed using mouth gags during CNT ventilation. CNT ventilation was shown to be superior to mask ventilation and is useful during dental treatment under general anesthesia.

[PMID: 23506278](#) [PubMed - in process] [PMCID: PMC3601724](#) [Available on 2013/9/1]

10. J Pediatr Gastroenterol Nutr. 2013 Mar 19. [Epub ahead of print]

Inflammatory Bowel Disease in Pediatric Patients with Cerebral Palsy.

Colson SB, Siparsky GL, Capocelli KE, Pan Z, Sokol RJ, Hoffenberg EJ.

[PMID: 23518488](#) [PubMed - as supplied by publisher]

11. *Pan Afr Med J.* 2013;14:25. doi: 10.11604/pamj.2013.14.25.896. Epub 2013 Jan 16.

Rickets obvious revealed by the loss of seizure control in a boy with cerebral palsy [Article in French]

Awa HD, Chelo D, Kinkela MN, Ndombo PO.

Centre Mère et Enfant de la Fondation Chantal BIYA, Cameroun ; Faculté de Médecine et de

[PMID: 23503922](#) [PubMed - in process] PMID: PMC3597856

Prevention and Cure

12. *Arch Iran Med.* 2013 Apr;16(4):213-6. doi: 013164/AIM.004.

Antenatal and Intrapartum Risk Factors for Cerebral Palsy in Term and Near-term Newborns.

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BACKGROUND: Cerebral palsy (CP) is one of the main disabilities in term-born infants. This study attempts to investigate the maternal and neonatal factors associated with CP. **METHODS:** This case-control study consisted of singleton term and near-term (36 or more weeks of gestation) newborns in Tehran health-care centers and was conducted over a 24- month period. Logistic regression analysis analyzed the data with SPSS 16.0. **RESULTS:** During the study period there were 53 infants in the case group and 106 in the control group. The main factors associated with CP were perinatal asphyxia [odds ratio (OR): 97.72; CI: 21.2-450.07], maternal age >35 years (OR: 20.89; CI: 1.05-412.62), and high risk pregnancy (OR: 0.2; CI: 0.04-0.932). **CONCLUSIONS:** Several maternal, antenatal and intrapartum factors increase the risk for CP. Identifying and avoiding risks for CP may lead to lower infant neurologic morbidity.

[PMID: 23496363](#) [PubMed - in process]

13. *Dev Med Child Neurol.* 2013 Mar 18. doi: 10.1111/dmcn.12095. [Epub ahead of print]

The role of migration and choice of denominator on the prevalence of cerebral palsy.

Van Naarden Braun K, Maenner MJ, Christensen D, Doernberg NS, Durkin MS, Kirby RS, Yeargin-Allsopp M.

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AIM: Differential migration and choice of denominator have been hypothesized to contribute to differences between period prevalence and birth prevalence of cerebral palsy (CP). The purpose of this study was to evaluate the effects of migration and choice of denominator on the prevalence of CP. **METHOD:** Data from the Metropolitan Atlanta Developmental Disabilities Surveillance Program and census and birth certificate files were used to calculate various CP prevalence estimates for 2000. **RESULTS:** The overall CP period prevalence was 3.2 (95% confidence interval [CI] 2.7-3.8) per 1000 8-year-olds and was similar for those born in Atlanta who resided there at age 8 years (3.3; 95% CI 2.7-4.1) and those born outside Atlanta who moved into Atlanta by age 8 years (3.0; 95% CI 2.3-3.9). CP prevalence in these two migration strata was similar by sex and race/ethnicity. CP birth prevalence of 8-year-olds in Atlanta in 2000 was 2.0 (95% CI 1.6-2.5) per 1000 live births in 1992. **INTERPRETATION:** The authors found no evidence to support the hypothesis that differential in-migration explained higher period than birth prevalence of CP in Atlanta. Comparability of CP prevalence across geographic areas will be enhanced if future studies report both period and birth prevalence.

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[PMID: 23506432](#) [PubMed - as supplied by publisher]

14. J Pediatr. 2013 Mar 13. pii: S0022-3476(13)00146-7. doi: 10.1016/j.jpeds.2013.02.003. [Epub ahead of print]

Long-Term Neurodevelopmental Outcome with Hypoxic-Ischemic Encephalopathy.

Perez A, Ritter S, Brotschi B, Werner H, Caflisch J, Martin E, Latal B.

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OBJECTIVES: To determine the long-term neurodevelopmental outcome for children after hypoxic-ischemic encephalopathy (HIE) without major disability, and to examine neonatal injury patterns detected on cerebral magnetic resonance imaging (MRI) in relation to later deficits. **STUDY DESIGN:** Prospectively enrolled children with HIE and neonatal cerebral MRI data (n = 68) were examined at a mean age of 11.2 years (range, 8.2-15.7 years). Eleven children had a major disability (ie, cerebral palsy or mental retardation). Brain injury was scored according to the region and extent of injury. **RESULTS:** Children without major disability (n = 57) had lower full-scale and performance IQ scores compared with norms (P = .02 and .01, respectively), and the proportion of children with an IQ <85 was higher than expected (P = .04). Motor performance on the Zurich Neuromotor Assessment was affected in the pure motor, adaptive fine motor, and gross motor domains, as well as in the movement quality domain (all P < .001). Watershed injury pattern on neonatal MRI correlated with full-scale and verbal IQ scores (P = .006 and <.001, respectively), but neonatal MRI pattern did not correlate with motor performance in children without major disability. **CONCLUSION:** Children who sustained neonatal HIE without major disability are at increased risk for long-term intellectual, verbal, and motor deficits. The severity of watershed injury is correlated with later intellectual performance. Long-term follow-up examinations are necessary for early detection of neurodevelopmental impairment and early initiation of adequate therapies.

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[PMID: 23498155](#) [PubMed - as supplied by publisher]

15. PLoS One. 2013;8(3):e58893. doi: 10.1371/journal.pone.0058893. Epub 2013 Mar 8.

Oleuropein Aglycone Protects Transgenic C. elegans Strains Expressing Aβ42 by Reducing Plaque Load and Motor Deficit.

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The presence of amyloid aggregates of the 42 amino acid peptide of amyloid beta (Aβ42) in the brain is the characteristic feature of Alzheimer's disease (AD). Amyloid beta (Aβ) deposition is also found in muscle fibers of individuals affected by inclusion body myositis (sIBM), a rare muscular degenerative disease affecting people over 50. Both conditions are presently lacking an effective therapeutic treatment. There is increasing evidence to suggest that natural polyphenols may prevent the formation of toxic amyloid aggregates; this applies also to oleuropein aglycone (OLE), the most abundant polyphenol in extra virgin olive oil, previously shown to hinder amylin and Aβ aggregation. Here we evaluated the ability of OLE to interfere with Aβ proteotoxicity in vivo by using the transgenic CL2006 and CL4176 strains of *Caenorhabditis elegans*, simplified models of AD and of sIBM, which express human Aβ in the cytoplasm of body wall muscle cells. OLE-fed CL2006 worms displayed reduced Aβ plaque deposition, less abundant toxic Aβ oligomers, remarkably decreased paralysis and increased lifespan with respect to untreated animals. A protective effect was also observed in CL4176 worms but only when OLE was administered before the induction of the Aβ transgene expression. These effects were specific, dose-related, and not mediated by the known polyphenolic anti-oxidant activity, suggesting that, in this model organism, OLE interferes with the Aβ aggregation skipping the appearance of toxic species, as already shown in vitro for Aβ42.

[PMID: 23520540](#) [PubMed - in process]

16. *Res Dev Disabil.* 2013 Mar 7;34(5):1669-1677. doi: 10.1016/j.ridd.2013.02.016. [Epub ahead of print]

Trends in prevalence and characteristics of post-neonatal cerebral palsy cases: A European registry-based study.

Germany L, Ehlinger V, Klapouszczak D, Delobel M, Hollódy K, Sellier E, Cruz JD, Alberge C, Genolini C, Arnaud C.

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The present paper aims to analyze trends over time in prevalence of cerebral palsy of post-neonatal origin, to investigate whether changes are similar according to severity and to describe the disability profile by etiology. Post-neonatal cases, birth years 1976 to 1998, were identified from the Surveillance of Cerebral Palsy in Europe collaboration (19 population-based registries). A recognized causal event occurring between 28 days and 24 months of age was considered to define the cases. Trends in prevalence were explored using graphical methods (Lowess and Cusum control chart) and modeled with negative binomial regressions. Over the study period, 404 cases were identified as post-neonatal cases (5.5% of the total). Mean prevalence rate was 1.20 per 10,000 live births (95% CI [1.08-1.31]). A significant downward trend was observed ($p=0.001$), with an accentuated decrease in the 1990s. The prevalence of severe cases which account for around one third of the total also significantly decreased over time ($p<0.001$). In 46% of cases, an infectious aetiology was reported; the corresponding prevalence significantly decreased since 1989. No significant decrease was observed for the rate of cases due to a vascular episode or of traumatic origin. Our results emphasize the need of large population-based surveillance systems to reliably monitor trends in prevalence in rare subgroups of children like those with acquired cerebral palsy. The decrease of the overall prevalence as well as those of the most severe cases may be partly due to public health actions targeted to prevent such events.

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