Cerebral palsy research news

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Interventions and Management

1.Longitudinal decline in upper-limb range of motion in adults with cerebral palsy

Erika Cloodt, Jenny Hedberg-Graff, Anna Lindgren, Marianne Arner, Evgenia Manousaki, Katina Pettersson, Elisabet Rodby-Bousquet

Dev Med Child Neurol. 2025 Aug 9. Online ahead of print.

Abstract
To analyse longitudinal changes in passive range of motion (ROM) in the upper limb in adults with cerebral palsy (CP).
Method: Passive ROM for shoulder abduction and flexion, supination, and elbow and wrist extension was analysed in a longitudinal cohort of adults aged 16 to 76 years from the Swedish CP registry. Individual ROM trajectories and mean ROM curves were calculated using the Manual Ability Classification System (MACS). A mixed-effects model was used to examine changes over 3 to 13 years 7 months.
Results: In total, 1395 adults with CP were analysed (769 males, 626 females; median age 26 years). A continuous decline in shoulder ROM, supination, and wrist extension was observed across all MACS levels. Decline rates differed between MACS levels for shoulder flexion, elbow extension, and wrist extension, with steeper declines at higher MACS levels (levels IV and V). Adults classified in lower MACS levels (I and II) had greater initial ROM and slower declines compared to adults classified in higher MACS levels.
Interpretation: Upper-limb ROM continuously declined in adults with CP, particularly at higher MACS levels. The varied decline rates highlight the need for tailored interventions and systematic follow-up to maintain ROM and functional ability, especially among individuals at higher risk.
PMID: 40781986

2.Precision rehabilitation for cerebral palsy will require robust measures of motor control development

Laura A Prosser

Dev Med Child Neurol. 2025 Aug 7. Online ahead of print.

Abstract
No abstract available.
PMID: 40771004

3.The effect of sensory integration therapy on upper extremity functions, trunk control and balance in children with cerebral palsy: a single-blind, randomized controlled study

Hilal Aktaş, Gülbin Ergin, Gözde Kaya Uçar

Dev Neurorehabil. 2025 Aug 5:1–7. Online ahead of print.

Abstract
This study aimed to investigate the effect of Sensory Integration Therapy (SIT) in children with cerebral palsy (CP). Twenty children with CP were randomly assigned to intervention and control groups. Quality of Upper Extremity Skills Test (QUEST), Trunk Control Measurement Scale (TCMS), and Pediatric Balance Scale (PBS) were used in pre-and post-treatment. There was a statistically significant increase in the dissociated movements sub-scale of the QUEST, dynamic reaching sub-scale of the TCMS, and PBS scores in the intervention group. There was a statistically significant increase in both dissociated movements and grasps sub-scale of the QUEST and PBS scores in the control group. In conclusion, SIT applications can be integrated into rehabilitation programs to improve dissociated upper extremity movements, dynamic trunk control, and balance control in children with CP.
PMID: 40762832

4.Assessment of hybrid nanocomposite AFOs for pediatric cerebral palsy: mechanical, spectroscopic, and finite element analysis

Noorhan Abdelgawad, Marwa M A Hadhoud, Mohamed Tarek El-Wakad, Reda Abdelbaset

Sci Rep. 2025 Aug 7;15(1):28865. Online ahead of print.

Abstract
Cerebral Palsy (CP) is a neurological disorder that affects motor function and causes gait abnormalities in children. Ankle-Foot Orthoses (AFOs) are external aiding devices that provide stability and improve mobility for pediatrics. However, conventional AFO materials often fail to achieve an optimal balance of strength, flexibility, and energy absorption for dynamic movements. This study introduces a novel composite material for pediatric ankle-foot orthoses (AFOs), based on Orthocryl and reinforced with multi-walled carbon nanotubes (MWCNTs) and polylactic acid (PLA). The proposed formulation is engineered to overcome the limitations of conventional materials by providing enhanced mechanical performance and improved functional suitability for clinical applications. Four composite concentrations were fabricated: pure Orthocryl, 0.5% MWCNTs, 0.5% MWCNTs/1.0% PLA, and 0.5% MWCNTs/1.5% PLA. Mechanical and morphological characterizations were performed using a universal testing machine for tensile, flexural, and impact testing, Fourier Transform Infrared Spectroscopy (FT-IR) for material composition analysis, and Field Emission Scanning Electron Microscopy (FE-SEM) for surface morphology examination. To simulate practical application, Finite Element Analysis was performed using ANSYS software, recognizing gait loading conditions. The experimental findings demonstrated that incorporating 0.5% MWCNT into Orthocryl significantly enhanced its mechanical properties, with a 12.5% increase in tensile strength (from 52.79 to 59.4 MPa), a 59.3% increase in flexural strength (from 52.08 to 82.93 MPa), and a 22% improvement in impact resistance (from 28.12 to 34.3 kJ/m²). These improvements confirm the effectiveness of MWCNT reinforcement. Additionally, FE-SEM and FT-IR analyses confirmed the uniform distribution of CNTs within the matrix and stronger interfacial bonding between the filler and polymer. Simulation results showed that the 0.5% MWCNT/1.5% PLA composite had the highest deformation (10.95 mm) with a safety factor of 1.12, indicating acceptable safety. In contrast, the 0.5% MWCNT composite showed the lowest deformation (4.17 mm), 12.6% less than pure Orthocryl, and the highest safety factor (3.2), reflecting an optimal balance of strength and flexibility for pediatric AFOs in CP patients.
PMID: 40775247

5.Effects of foot intrinsic muscle dynamic stretching intervention on static balance, gait parameters and gross motor ability with hemiplegic cerebral palsy: a randomized controlled pilot study

YoungHwan Kwag, DongHwan Park

Brain Dev. 2025 Aug 5;47(5):104414. Online ahead of print.

Background: The foot intrinsic muscle dynamic stretching (FIMDS) intervention can increase ankle stability, stabilize the foot arch, and induce an increase in gross motor ability.
Objectives: The objective of this study is to compare the effects of a 6-week program of FIMDS with those of a slant board (SB) on static balance with open and closed eyes, gait parameters (gait speed, cadence), and gross motor ability in children with cerebral palsy (CP).
Methods: Participants were randomized into either the FIMDS (n = 7) or SB (n = 7) group. Patients in both groups underwent standard physiotherapy for 30 min per session. Additionally, FIMDS and SB interventions were performed in 3 sets of 10 repetitions, 3 times a week for 6 weeks. Static balance (with open and closed eyes), gait speed, cadence, and gross motor ability were measured after the 6 weeks of training.
Results: After 6 weeks of training, both the FIMDS and SB groups showed significant improvement in all outcome measures compared to baseline ($p < .05$). Furthermore, the FIMDS group demonstrated greater improvement in open eyes static balance, gait speed, cadence, and gross motor ability while standing compared to the SB group ($p < .05$).
Conclusions: This study demonstrated that FIMDS training, combined with standard physiotherapy, improved open eyes static balance, gait speed, cadence, and gross motor ability while standing in children with hemiplegic CP.
PMID: 40768882

6.A pilot study: effect of a half-sloped seat surface on sitting posture in adults with cerebral palsy using a wheelchair

Shingo Umeda, Yuji Nakamura, Yasuhito Sengoku

Disabil Rehabil Assist Technol. 2025 Aug 2:1-13. Online ahead of print

Purpose: This study aimed to investigate the effects of a half-sloped (HS) seat surface as a new approach to seating on individuals with cerebral palsy. Materials and methods: Eight adults with cerebral palsy, with a mean age of 35.88 ± 6.08 years, were enrolled in this study to compare their seating postures and upper limb function between both a standard seat and an HS seat. Measurements included pelvic tilt angle, hip joint angle, thoracic flexion angle, craniovertebral angle and upper limb function test as Simple Test for Evaluating Hand Function (STEF) scores. Result: The HS seat resulted in an increase in the flexion angle of the thoracic spine by 17.37°, an increase in displacement by 4.07% and a reduction in forward head posture by 14.00°. Additionally, the STEF scores on both hands improved by 14.00 points. The results of this study suggest that the HS seat might improve sitting posture and upper extremity function in individuals with cerebral palsy. Conclusion: The HS seat might contribute to improving the quality of life in these individuals by promoting pelvic stability and maintaining the physiological curvature of the spine. Further large-scale studies and long-term follow-up are needed to validate the clinical efficacy of the HS seat.
Plain language summary
To improve the sitting posture of people with cerebral palsy and reduce their physical burden. Promote activity in a sitting position in cerebral palsy patients. Improves the sitting posture of people with cerebral palsy and reduces postural collapse.
PMID: 40751514

7.Personalized goal setting and predictors of functional gains following constraint-induced movement therapy in preschool-aged children with unilateral cerebral palsy

Youngsub Hwang, Jeong-Yi Kwon

PLoS One. 2025 Aug 6;20(8):e0329002. Online ahead of print.

Objective: This study aimed to identify caregiver-selected goal characteristics that predict functional improvements following constraint-induced movement therapy (CIMT), offering novel insights into personalized rehabilitation for younger children with unilateral cerebral palsy (UCP).
Methods: This study included 19 children with UCP aged 4–6 years who participated in a three-week CIMT program comprising 15 sessions (30 hours total), during which the unaffected hand was constrained to encourage intensive use of the affected limb. Caregivers identified five meaningful rehabilitation goals per child using the Canadian Occupational Performance Measure, categorizing them into self-care, productivity, or leisure domains and ranking them by importance. Upper-limb function was objectively evaluated using the Assisting Hand Assessment before and immediately after CIMT. Linear regression analyses identified the factors influencing goal selection, and least absolute shrinkage and selection operator regression determined whether prioritized goal types predicted improvements in upper limb function.
Results: Self-care goals were most frequently selected (72.6%), followed by leisure (26.3%) and rarely productivity (1.1%). Leisure goal selection was significantly associated with greater baseline upper limb range of motion and lower baseline occupational performance scores. The higher prioritization of goals involving quiet leisure activities (e.g., arts, crafts, computer play) and dressing tasks (e.g., buttoning, zipping) significantly predicted greater functional improvements post-intervention.
Conclusion: This study provides important new evidence indicating that caregiver-selected rehabilitation goals that are closely aligned with a child's latent motor capacities positively affect functional outcomes. These findings underscore the clinical importance of individualized, family-driven goal setting for optimizing therapeutic effectiveness in preschool-aged children with UCP.
PMID: 40768440

8.The Impact of Whole Body Vibration on Muscle Tone, and Sensory Motor Function in Children with Spastic Diplegic Cerebral Palsy

Hisham Mohamed Hussein, Norah Dakheel, Hand Zamel M Alshammari, Amsha Alhumaidi Alshammari, Ahmed M Gabr, Shamekh Mohamed El-Shamy, Shahanawaz Sd, Rehab Hussien A, Ibrahim Metwally Dewir, Amany Raafat Mohamed, Ahmed Abdelmoniem Ibrahim

Clinical Trial J Multidiscip Healthc. 2025 Jul 29:18:4353–4363. Online ahead of print.

Purpose: Children with diplegic cerebral palsy (CP) have limited muscle tone, function, and sensorimotor function. Whole-body vibration (WBV) has been suggested to enhance muscle tone and function in diplegic CP. However, there were limited studies involving the effect of WBV on the tone and function of diplegic CP; we aimed to investigate the effect of WBV on muscle tone, function, and sensorimotor function in children with CP.
Patients and methods: This is a single-blind randomized controlled clinical trial involving 54 spastic diplegic CP child recruited from local rehabilitation centers in the Ha'il region of Saudi Arabia, they were randomly divided into the WBV group (n = 28 with mean age of 9.47±1.92), which received standard physical therapy and WBV therapy, and the control group (n = 26 with mean age of 9.73±1.62) they received standard physical therapy three time per week for four weeks; Muscle tone, function, strength and Sensory motor integration were evaluated pre and post interventions.
Results: At baseline, the two groups had no significant differences. After treatment, the measured outcomes (function, muscle strength, and sensory motor integration) showed statistically significant differences ($p < 0.05$). However, muscle tone was not substantially improved ($p = 0.10$). In addition, within-group comparisons demonstrated substantial effects ($p < 0.05$) except Spasticity, Function, and trace assessment of the control group, where the p-values were (0.33, 0.06, and 0.54, respectively).
Conclusions: According to the findings in this study, both conventional physical therapy and WBV are beneficial in treating spastic diplegia.
PMID: 40756614

9.Longitudinal reference centiles for the Gross Motor Function Measure-66 in children and adolescents with cerebral palsy

Ibrahim Duran, Leonie Schafmeyer, Bruno Lentzen, Karoline Spiess, Titus Keller, Kyriakos Martakis, Eckhard Schoenau

Dev Med Child Neurol. 2025 Aug 5. Online ahead of print.

Aim: To establish novel longitudinal reference values for the Gross Motor Function Measure-66 (GMFM-66) in children and adolescents with cerebral palsy aged 3 to 18 years, to enable more accurate assessments of changes in motor function.
Method: This was a single-centre retrospective analysis of patients who participated in a rehabilitation programme between January 2006 and March 2022. The GMFM-66 was used to measure gross motor function. Paired GMFM-66 measurements from the follow-up phase of the rehabilitation programme were used to establish a reference centile for the change in GMFM-66 over a 6-month period using the lambda-mu-sigma method.
Results: Reference centiles for GMFM-66 changes (over a 6-month period; ±1 month) were created using 1190 longitudinal data pairs of GMFM-66 measurements (mean age 8 years 4 months [standard deviation 7 years 11 months] at start of follow-up), Gross Motor Function Classification System levels I to V. The z-scores for GMFM-66 change of a validation dataset by the new tool and the previously described method to quantify a change in GMFM-66 by individual effect size were highly correlated (Pearson's rank correlation coefficient 0.981 [95% confidence interval 0.979–0.984], $p < 0.001$)
Interpretation: The new reference values showed a high correlation with the previously published reference values, which were limited to an age range of 3 to 12 years. The new reference values can be applied from an age of 3 to 18 years. This facilitates the evaluation of medical treatment after a 6-month period also for children with cerebral palsy who are older than 12 years.
PMID: 40765172

10.Adaptive Sports Exposure Impacts Pediatric Orthopaedic Surgeon Comfort in Treating Patients With Disabilities

Charlotte F Wahle, Nora A Galoustian, Nicole J Newman-Hung, Alexander Rueda, Christina Im, Eghosa Edogun, Charlotte Poplawski, Sharon L Hame, Rachel M Thompson

J Pediatr Soc North Am. 2025 May 26:12:100209. Online ahead of print.

Abstract
Background: Pediatric patients with physical disabilities often have difficulty accessing providers who are comfortable treating this unique patient population. The purpose of the study is to identify factors associated with increased pediatric orthopaedic surgeon familiarity in treating patients with disabilities and to assess whether involvement with adaptive sports (AS) improves their comfort level in treating these patients.
Methods: An anonymous 36-question survey was administered from May to June 2024 to members of the Pediatric Orthopaedic Society of North America (POSNA). Demographic information and clinical practice details were collected. Survey questions assessed the comfort level of pediatric orthopaedic surgeons with treating and counseling patients with various types of disabilities, as well as their familiarity with AS. Data analysis was performed using chi-squared analysis, fisher exact test, and the Mann-Whitney U.
Results: A total of 190 responses were recorded (13% of POSNA membership). Participants' ages ranged from 32 to 90; 93% of respondents completed fellowship training in pediatric orthopaedic surgery. Surgeon experience ranged from <5 to >20 years in practice. Surgeons with more experience had significantly higher comfort levels in treating patients with physical disabilities and counseling them regarding sports participation ($P < .01$, $P < .001$, respectively). Surgeons who treat a higher proportion of patients with physical disabilities were also significantly more likely to have attended an AS event ($P = .02$). Furthermore, there was a statistically significant association between AS event attendance and comfort counseling patients with physical disabilities on sports risks ($P < .001$).
Conclusions: Pediatric orthopaedic surgeons with more practice experience and with greater exposure to patients with disabilities are more comfortable in treating and counseling these patients with disabilities. However, the data suggests that attending an AS event may improve pediatric orthopaedic surgeons' comfort and confidence in treating patients with disabilities regardless of practice experience. While AS have well-documented benefits for participants—including participation, community, and health benefits—these events may also provide an excellent opportunity for exposing pediatric orthopaedic surgeons to patients with disabilities early in their career, with significant impact on their ability to treat patients with disabilities.
Key concepts: (1)Pediatric orthopaedic surgeons with more years in practice report significantly greater comfort treating and counseling patients with disabilities.(2)Surgeons who have attended adaptive sports (AS) events demonstrate significantly higher comfort levels in caring for patients with disabilities, regardless of years in practice.(3)Many physicians lack formal training and experience caring for individuals with disabilities, highlighting the need for improved disability education in medical training.(4)Incorporating AS exposure into early medical education may help address healthcare disparities and build a more inclusive physician workforce.
PMID: 40756151

11.Sleep and breathing in children with cerebral palsy: it's complicated….!

David Gozal

Editorial J Pediatr (Rio J). 2025 Aug 5:101434. Online ahead of print.

Abstract
No abstract available.
PMID: 40780267

12.Investigating the Effects of a High-Load Resistance Training Program on Bone Health in Wheelchair Users (the BoneWheel Study): Protocol for a Randomized Controlled Trial

Linn Christin Risvang, Vegard Strøm, Jan-Willem van Dijk, Hannah Rice, Øyvind Sandbakk, Lars Peder Bovim, Julia Kathrin Baumgart, Marte Bentzen, Truls Raastad, Kristin L Jonvik

JMIR Res Protoc. 2025 Aug 8:14:e70125. Online ahead of print.

Background: Low mechanical loading of the bones of wheelchair users leads to low bone mineral density (BMD) and increased risk of bone fractures and associated complications. High-load resistance training of the upper body is one way to achieve mechanical loading of the lumbar spine and the hip bones. In addition, maintaining good nutritional status with key nutrients for bone remodeling, that is, vitamin D and calcium, is important for bone accrual.
Objective: This study aims to investigate the effect of 24 weeks of high-load resistance training combined with nutritional optimization on lumbar spine BMD. Secondary objectives are to investigate the effects of the intervention on (1) bone and physical health parameters, such as bone turnover blood markers, nutritional status, body composition, and maximal muscular strength, as well as (2) exercise motivation and mental health.
Methods: In this randomized controlled trial, we aimed to include 60 wheelchair users with nonprogressive impairments. Participants were randomly allocated to 24 weeks of either (1) high-load resistance training and nutrition optimization or (2) nutrition optimization only, stratified by sex and sport activity status. The training program consisted of 3 weekly sessions comprising 6 exercises periodized in low-, moderate-, and high-load phases. The nutritional optimization aimed to ensure sufficient intake of protein, vitamin D, and calcium. BMD and body composition; maximal muscular strength; and nutritional, physical, and mental health status were assessed at baseline, midpoint, and postintervention visits. Furthermore, follow-up assessments of a subgroup were conducted at 6 to 18 months after the intervention. This protocol was approved by the Regional Committee for Medical and Health Research Ethics South-East, Norway.
Results: Recruitment occurred between November 2022 and 2023. A total of 68 wheelchair users were screened for eligibility, of whom 45 (66%) were enrolled and allocated to one of the study groups (n=24, 53% training group; n=21, 47% control group). At the midpoint and postintervention visits, 36 (n=17, 47% and n=19, 53%, respectively) and 33 (n=14, 42% and n=19, 58%, respectively) participants were assessed, respectively. Analysis of the data collected at the screening visit commenced in spring 2024, while analyses of data collected at the baseline and retest visits began in autumn 2024. Publication of the results of this study is expected by the end of 2025.
Conclusions: This protocol presents the first randomized controlled trial of a high-load resistance training intervention in wheelchair users, focusing on bone, physical, and mental health. The results will contribute to new knowledge in exercise science for this population and generate novel hypotheses for future studies.
PMID: 40779767

13.Prevalence and Potential Risk Factors of Ocular Disorders Among Institutionalised Adults With Intellectual Disabilities—A City-Wide Survey in Taipei City

Ching-Ju Hsieh, Tzu-Hsun Tsai, Fu-Gong Lin, Yu-Lung Chiu, I-Mo Fang

J Intellect Disabil Res. 2025 Aug 5. Online ahead of print.

Background: To conduct a city-wide survey and investigate the risk factors of ocular disorders among institutionalised adults with intellectual disabilities (ID) in Taipei City.
Method: A cross-section city-wide ophthalmic survey was conducted in Taipei City from 2016 to 2017, involving full-day residents with ID aged over 18. Participant characteristics, including age, gender, ID severity and associated diseases, were collected for multiple logistic regression analysis to identify ocular disorder risk factors.
Result: A total of 687 participants, comprising 70.9% of the eligible individuals, were included. Refractive errors (73.8%), strabismus (32.6%), ocular hypertension (26.0%) and cataract (15.3%) were the most common ocular disorders. Myopia (73.2%) is the most common refractive error, with 14.6% being high myopia. Down's syndrome (DS) was a common risk factor for developing strabismus (OR, 2.87; 95% confidence interval [CI], 1.54 to 3.35), nystagmus (OR, 6.50; 95% CI, 2.22 to 19.0), high myopia (OR, 2.62; CI, 1.85 to 3.09), high astigmatism (OR, 3.06; CI, 1.65 to 5.69) and cataracts (OR, 8.00; CI, 3.50 to 18.30), while it served as a protective factor against ocular hypertension (OR, 0.14; CI, 0.03 to 0.62). Cerebral palsy (CP) was identified as a common risk factor for strabismus (OR, 2.17; CI, 1.16 to 4.05), nystagmus (OR, 4.22; CI, 1.51 to 11.8) and high myopia (OR, 2.22; CI, 1.04 to 4.73).
Conclusion: High prevalence of myopia, strabismus, ocular hypertension and cataract was observed in institutionalised adults with ID. DS and CP were more significant risk factors than ID severity for ocular disorders. Regular ophthalmic exams, particularly monitoring intraocular pressure, are crucial for this population.
PMID: 40764788

14."They have just as much right to learn": Mother's perceptions of sexual and reproductive health communication with daughters with a physical disability and preferences for an intervention

Courtney S Streur, Jodi M Kreschmer, Rebecca Howland, Monica W Rosen, Daniela A Wittmann, Claire Z Kalpakjian

J Sex Med. 2025 Aug 3:qdaf180. Online ahead of print

Abstract
No abstract available
PMID: 40753510

15.Assistive technology in the home is choice and control… it's freedom": perspectives of people with physical disability using electronic assistive technologies in the home

Janine C Yaffe, Jacquie Ripat, Gordana Dermody, Michèle C Verdonck

Disabil Rehabil Assist Technol. 2025 Aug 9:1–15. Online ahead of print.

Objective: People with physical disabilities can use electronic assistive technologies in their homes to increase their independence. These technologies range from disability specific environmental controls systems to mainstream smart home technologies and combinations of both. The purpose of this study was to explore the perspectives of persons with physical disabilities on their experiences using these technologies in their homes to inform future best practice.
Methods: This qualitative descriptive study used a World Café method underpinned by appreciative inquiry. Nine participants with spinal cord injuries, cerebral palsy or acquired brain injury participated in four World Café discussions. Inductive thematic analysis was used to analyse verbatim transcriptions.
Results: Five themes were identified: "Using Mainstream Technology", "Navigating Person-Technology Fit Amidst Change", "Making Technology Work in the Home", "Positive Impacts of Technology", and "Frustrations with Using Technology in the Home". These themes supported expected benefits and challenges. In addition, the opportunities provided by mainstream technology in terms of availability and affordability, funding frustrations and poor trust of suppliers were described. Making technology work required support as well as technological safeguards.
Impact: Mainstream technology has improved and broadened possibilities for electronic assistive technology use in the home, which can be complex. It provides psychosocial benefits, but is also frustrating. Furthermore, using technology is a dynamic evolving journey as individual users must navigate changes in search of best person-technology fit. Successful use of technology requires support, as well as backup systems and safeguards to combat poor reliability.
Plain language summary
Electronic assistive technology in the home includes disability specific devices and mainstream smart technology. Both support autonomy, psychosocial and physical health. Allied health professionals and prescribers need to be aware of the complexity of each person’s unique journey over time when they use electronic assistive technology in the home. Maximising the benefits of technology in the home requires navigating the frustrations of technology reliability, funding challenges, and finding trustworthy suppliers. A holistic integrated approach to recommending and prescribing electronic assistive technology in the home, must consider alternative backup solutions to safeguard the user.
PMID: 40781998

16.The Wizard Apprentice: A Serious Games System in Immersive VR as a Feasible Rehabilitation Approach in Children with Cerebral Palsy

Cristian Camardella, Federica Serra, Caterina Linciano, Chiara Malasoma, Gabriele Carrieri, Sara Aliboni, Ilaria Bortone, Federico Posteraro, Luca Bonfiglio, Daniele Leonardis

IEEE Trans Neural Syst Rehabil Eng. 2025 Aug 4:PP. Online ahead of print.

Abstract
Virtual reality offers the opportunity to engage the participant in challenging rehabilitation exercises, proposed in the shape of serious games. Modern VR technologies can further enhance usability, allowing the participant to seamlessly interact with VR environment with bare hands, without need of external tracking systems and complex setups. In children neurorheabilitation engagement can promote motivation and attention to the exercise, two key elements for effectiveness of the rehabilitation process. In this work we developed a rehabilitation system composed of three serious games in immersive VR, with motor exercises targeting the upper limb and trunk in children with Cerebral Palsy. The participant plays in the role of a wizard apprentice, called to cast spells, to prepare potions and to ride a magic eagle. These game scenarios involve coordinated motor functions related to trajectory tracking, pick-and-place with prono-supination, and trunk balance. The presented pilot study (12 CP children, 24 sessions), focuses on the feasibility assessment of the rehabilitation method, then, it allows a more in depth analysis on the adaptation and progress of the exercise parameters through data recorded during the whole treatment. The study shows that immersive VR games are a feasible approach in rehabilitation procedures, with positive results regarding acceptability, retention, adherence to the planned exercises and absence of adverse effects in the long-term use. They also show promising results in improvements of motor functions, although a direct comparison with a control group was not included in the study.
PMID: 40758502

17.Design of a Robotic Infant Simulator to Understand the Role of the Trunk in Infant Postural Stability and Center of Pressure

O Francis Sowande, Dwight Koyner, Laura Prosser, Michelle J Johnson

ROMAN. 2024 Aug:2024:1005-1012. Epub 2024 Oct 30

Abstract
Infants at risk for developmental delays such as Cerebral Palsy, can often be distinguished through observation of their motion and postural stability. In an effort to provide more accessible and quantitative metrics for the early detection of such impairments, this study focuses on the development of a 6-degree of freedom (DOF) robotic infant simulator. The robotic simulator provides insight into the relationship between infant motion and center of pressure (COP), a common measure that is capable of distinguishing impaired infants through quantification of postural stability. We focus on the impact of a 2 DOF motion in the trunk on COP through two experiments where we 1) Compare the impacts on COP of the limbs and the trunk, and 2) Compare the robot's COP to a real infant's. Our results indicate that motion in the trunk plays a strong part in replicating an infant's COP. Additionally, we can observe that changes in COP exhibit clear and repeatable patterns with respect to motion in each DOF. Future directions suggest a look at how different motions in the trunk affect infant COP.
PMID: 40756020

18.Unravelling genetic etiology of cerebral palsy: findings from a Slovenian pediatric cohort

Ula Arkar Silan, Ana Trebše, Jernej Kovač, Mihael Rogac, Anja Troha Gergeli, Robert Šket, Tina Bregant, David Neubauer, Borut Peterlin, Damjan Osredkar

Front Neurol. 2025 Jul 23:16:1615449. Online ahead of print.

Introduction: Cerebral palsy (CP) is a permanent movement or postural disorder due to non-progressive injury to the developing brain, with recent research suggesting a genetic contribution in many patients. This study aimed to investigate the genetic etiology of CP in Slovene children without a previously suspected genetic cause or with prior negative genetic testing.
Methods: All children born after 2003 from the Slovenian National Registry of Cerebral Palsy (SRCP) without an established genetic diagnosis were invited to participate in this cross-sectional study. Whole exome sequencing (WES) was conducted, followed by analysis of 110 CP-associated genes. Thirteen patients underwent additional family segregation by Sanger sequencing. Genetic findings were classified according to the ACMG guidelines.
Results: The study included 136 children, of whom 68 (50%) were male. Spastic CP was identified in 85% of the participants, dyskinetic in 13%, and ataxic in 2%. Gross Motor Function Classification System (GMFCS) levels varied, with the majority (36%) classified as level I. Pathogenic variants, likely pathogenic variants, or 'de novo' variants of unknown significance (VUS) were identified in nine children (6.6%) in ATL1, CTNNB1, DYRK1, KMT2A, PROC, SPAST, ZC4H2, and ZSWIM6. Among these nine children, two had normal brain Magnetic Resonance Imaging (MRI) and three had an unsuspicious medical history.
Conclusion: This study identified plausible, possible, or definite genetic etiologies in a cohort of children with CP. Apart from the exclusion of individuals with a previously established genetic diagnosis, no other selection criteria were applied, allowing for an inclusive assessment of genetic contributions within this population. With the advent of personalized medicine and genetic treatment, understanding the genetic underpinnings of CP is crucial for targeted therapy.
PMID: 40771987

19.The economic and social burden of pediatric cerebral palsy in Spain: a cost-of-illness study

Diana Marcela Nova-Díaz, Paloma Arana-Rivera, Eduardo Sánchez-Iriso, Sergio Aguilera-Albesa

Front Public Health. 2025 Jul 23:13:1589114. Online ahead of print.

Background: Cerebral palsy (CP) is the leading cause of motor disability in children and a lifelong condition with no cure, imposing a significant economic burden on families and healthcare systems. However, the economic impact of pediatric CP remains underexplored in Spain, hindering the development of cost-effective policies. Cost-of-illness (COI) studies are essential to quantify disease burden and guide resource allocation. This study aims to classify and estimate the economic and social costs of pediatric CP in Spain from a societal perspective, considering healthcare, government, and family burdens. Additionally, it evaluates the caregiving burden experienced by primary caregivers.
Methods: A bottom-up, disease-specific COI study was conducted from a societal perspective using data from a population-based epidemiological registry of CP. Data collection included structured questionnaires and administrative records from regional healthcare and government sources, covering a 1-year period. The Zarit Burden Interview was used to assess caregiver burden. The study captures direct, indirect, and out-of-pocket costs, including productivity losses associated with caregiving.
Results: The study included 148 children with CP (mean age: 9.72) and their primary caregivers (66% female, mean age: 42.97 years). Medical care costs averaged €3,801 (3.72%), while out-of-pocket expenses totalled €7,041 (6.89%), largely driven by complementary and alternative therapies used by 64% of families. Special education represented €8,932 (8.75%), whereas caregiver productivity losses were the largest component (€60,638; 59.37%). The mean annual societal cost per child was €102,135, over thirty times Spain's mean per capita healthcare expenditure. However, using a conservative assumption that valued the caregiver's time at the minimum wage, the social costs would be €70,190 per child. Children with severe motor impairment (GMFCS III–V) had nearly twice the cost of those with milder impairments (GMFCS I–II) (1.96; 95% CI: 1.92–2.01).
Conclusions: The economic burden of pediatric CP is largely driven by caregiving and non-medical costs, highlighting gaps in financial and social support. These findings call for targeted policies to reduce caregiver strain and enhance funding for assistive services, improving equity in CP care. Additionally, comprehensive cost-effectiveness analyses are needed to guide resource allocation and ensure sustainable support strategies.
PMID: 40771253

20.Neurodevelopmental and social determinants of school support received by children born preterm

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Background: Children born preterm face higher risks of neurodevelopmental difficulties that, with social vulnerabilities, may impair school performance. We described and assessed determinants of receiving school support in preterm-born children in France.
Methods: We used data from the prospective population-based cohort of births before 35 weeks' gestation in France, EPIPAGE -2, to estimate crude rates and adjusted relative risks (using multivariable, mixed-effects generalized linear models) of receiving school support at age five, by children's neurodevelopment at five, sociodemographic characteristics, and region.
Results: Out of 3,007 children, 99% attended mainstream school at age five, of whom 9% received school support. Support was more often received by boys (11%; aRR = 1.37) than girls (6%), children born at 24–27 weeks' gestation (21%; aRR = 2.78 compared to 32–34 weeks), and children with moderate or severe neurodevelopmental impairments (MSNDI: cerebral palsy, cognitive impairment, visual impairment or blindness, and/or hearing impairment or deafness) (39%; aRR = 17.25 compared to none). Receiving support was not associated with sociodemographic characteristics, after adjusting for covariates.
Conclusions: Neurodevelopmental impairment is a key determinant for receiving school support. However, 9% of the cohort and under 40% of children with MSNDI were receiving support, raising questions on whether unmet needs for school support exist in France.
Impact: This study provides an overview of school support received at age five by children born before 35 weeks' gestation in France, and associated determinants. Less than 10% of the total cohort and 40% of children with a moderate or severe neurodevelopmental impairment were receiving school support. Cognitive and neurodevelopmental impairments were key determinants for receiving school support, but sociodemographic characteristics were not. Our results raise questions about whether unmet needs for school support exist, calling for further research on the support available in schools, decision-making processes for allocating them, and the psychosocial and academic consequences of their provision on children.
PMID: 40760173

21.Patient experience and satisfaction level in telerehabilitation

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Purpose: Telerehabilitation has emerged as a significant innovation in remote healthcare delivery, offering an effective alternative, particularly for patients with mobility limitations. However, there is a need for further evidence regarding the impact of telerehabilitation services on patient experience and satisfaction levels. This study aims to evaluate the experiences and satisfaction levels of patients receiving telerehabilitation services. Materials and methods: A total of 263 patients with different neurological and motor disorders (90 stroke, 32 cerebral palsy, 77 Parkinson's disease and 64 speech disorders) were included in the study. Participants completed the Telemedicine Patient Scale and the Telemedicine Satisfaction and Usefulness Scale. Additionally, in-depth qualitative interviews were conducted with 20 patients. Survey data were analysed using statistical methods, while qualitative data were examined through thematic analysis. Results: The mean total score on the Telemedicine Patient Scale was found to be 78.84 ± 8.01 while the mean total score on the Telemedicine Satisfaction and Usefulness Scale was 96.31 ± 9.5. Qualitative interviews revealed that patients perceived telerehabilitation as an accessible and effective rehabilitation method; however, they also reported certain limitations, such as technical difficulties and a lack of personal interaction. Conclusions: Findings indicate that telerehabilitation is widely accepted in terms of patient experience and satisfaction; however, there are areas for improvement. Strengthening the technical infrastructure and enhancing patient-health professional interaction may improve the effectiveness of telerehabilitation services. Future studies should focus on examining differences among patient groups in greater detail.
Plain language summary
Telerehabilitation significantly improves patient accessibility to rehabilitation services, especially for individuals with mobility limitations. Patient satisfaction with telerehabilitation services is strongly linked to personalised care, time efficiency and enhanced healthcare provider communication. Strengthening technical infrastructure and promoting digital literacy among patients can further increase the effectiveness of telerehabilitation services. The integration of telerehabilitation into routine rehabilitation practice may reduce healthcare costs and enhance service sustainability. Mixed -method evaluation provides a comprehensive understanding of patient experiences, supporting the future development of patient-centred digital rehabilitation programs.
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22.The dual risk of research funding and federal assistance program budgetary cuts in cerebral palsy care in the United States

Devika A Shenoy, Anthony A Catanzano

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Abstract
No abstract available.
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23.Effectiveness of video assisted teaching program for caregivers on gross motor outcome among children with cerebral palsy undergoing hyperbaric oxygen therapy: A quasi-experimental study

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Abstract
Caregivers play a crucial role in the care of children with cerebral palsy, and their practices greatly influence the development of gross motor skills. A quasi-experimental research design was utilized in the study. This study was conducted in the Hyperbaric Oxygen Therapy Unit at Nasser Institute for Research and Treatment in Cairo Governorate, Egypt. A purposive sample of 76 caregivers and their children with cerebral palsy (age 3–12 years, gross motor level I–III) were assigned to study and control groups. The study group underwent hyperbaric oxygen therapy treatment and received video assisted teaching program for about eight months. Tool I: An interviewing questionnaire comprised of two parts: caregivers' sociodemographic characteristics and children's personal characteristics and medical history. Tool II: Caregiver Priorities & Child Health Index of Life with Disability to evaluate caregivers practices. Tool III: The Gross Motor Function Measure-88 is used to evaluate changes in the gross motor functions of children with cerebral palsy. The findings revealed that 71.1% and 65.8% of the study and control groups of caregivers were mothers with mean ages of 33.03 ± 4.750 and 32.42 ± 5.006 years, respectively. Before the implementation of the video-assisted teaching program, 34.2% of the children in both the study and control groups exhibited a total gross motor level I. After the program, this percentage increased to 84.2%. The analysis indicated a highly significant positive correlation between the total practices of the studied caregivers and the gross motor skills of their children with cerebral palsy following the implementation of the program. The video-assisted teaching program significantly enhanced the studied caregivers practices regarding care of their children with cerebral palsy, which positively affected gross motor skills among children with cerebral palsy of studied caregivers.
PMID: 40764644

Prevention and Cure

24.Punctate white matter lesions predict risk for cerebral palsy: further evidence for routine brain MRI in preterm infants

Thiviya Selvanathan, Dawn Gano

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Abstract
No abstract available.
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25.Exploratory analysis of contributory factors for cerebral palsy during labor involving neuraxial analgesia: From the Japan Obstetric Compensation System for Cerebral Palsy

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Aim: This study aimed to reveal factors contributing to cerebral palsy owing to intrapartum hypoxia during labor involving neuraxial analgesia using a nationwide database in Japan.
Methods: We retrospectively reviewed 102 reports of cases involving the use of anesthesia during labor, selected from reports on the causes of cerebral palsy, which were analyzed by the Japan Obstetric Compensation System Causal Analysis Committee between 2009 and 2019. Among these, 85 deliveries involved neuraxial analgesia. Of these, 39 cases were identified in which cerebral palsy was associated with intrapartum hypoxia and acidosis. These cases were classified into three categories based on the presumed contributing factors to cerebral palsy, namely anesthesia-related complications, obstetric complications, and labor progress. Clinical characteristics and intrapartum management issues were descriptively analyzed.
Results: Neuraxial analgesia was implicated in five of the 39 cases (12.8%), with direct involvement in one case of total spinal anesthesia. Obstetric complications (20.5%) and labor progress-related issues (76.9%) were more frequently associated with cerebral palsy. Intrapartum management problems were identified in most cases, including inappropriate cardiotocography interpretation (79.5%) and uterotonic use (38.5%). Anesthesia-related concerns, such as insufficient maternal or fetal monitoring, were observed in some cases.
Conclusions: Neuraxial analgesia was infrequently the direct cause of cerebral palsy; however, suboptimal labor management was identified in many cases. Improved monitoring, timely intervention, and standardized protocols are essential to reduce cerebral palsy risk during neuraxial analgesia-supported deliveries. Although rare, serious anesthesia-related complications also underscore the significance of vigilance in anesthetic practice.
PMID: 40769772

26.Long-Term Neurodevelopmental Outcomes After Antenatal Corticosteroid Therapy in Late Preterm Twins: A Nationwide Retrospective Cohort Study

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Background: In women with singleton pregnancy who are at risk of late preterm delivery, administration of antenatal corticosteroids is recommended to reduce neonatal respiratory complications. However, the adoption of this practice is not widely accepted in twin pregnancies because of a lack of evidence regarding both the effectiveness and long-term safety of corticosteroids. This study was conducted to evaluate the long-term neurodevelopmental outcomes of twins according to the administration of antenatal corticosteroid in late preterm.
Methods: This nationwide population based retrospective cohort study included twins who were delivered late preterm (34+0–36+6 weeks) between 2007 and 2010. The study population were divided into 2 groups according to the administration of preterm antenatal corticosteroids. Group 1 included twins from mothers who were administered antenatal corticosteroids in late preterm (with late preterm corticosteroids), and group 2 included twins whose mothers were not administered antenatal corticosteroid (without corticosteroids). The risk of long-term adverse neurodevelopmental outcomes was compared between the 2 groups. The composite adverse neurodevelopmental outcome was defined as the occurrence of at least one of the following: autism, cerebral palsy, speech articulation disorder, developmental disorders of scholastic skills, or developmental disorders of motor function.
Results: During the study period, 9,450 children met the inclusion criteria: 1,476 children in group 1 (with late preterm corticosteroids) and 7,974 children in group 2 (without corticosteroids). There was no statistically significant difference in the long-term adverse neurodevelopmental outcomes between the 2 groups. This result was consistent even after adjusting for covariates (adjusted hazard ratio 0.973 [95% confidence interval, 0.811–1.166]).
Conclusion: The risk of long-term adverse neurodevelopmental outcomes did not increase after antenatal corticosteroid administration in twin children who were born in late preterm.
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