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Interventions and Management

1. Development of bimanual performance in young children with cerebral palsy.

Klevberg GL, Elvrum AG, Zucknick M, Elkjaer S, Østensjø S, Krumlinde-Sundholm L, Kjekken I, Jahnsen R.

Dev Med Child Neurol. 2018 Feb 2. doi: 10.1111/dmcn.13680. [Epub ahead of print]

AIM: To describe the development of bimanual performance among young children with unilateral or bilateral cerebral palsy (CP). **METHOD:** A population-based sample of 102 children (53 males, 49 females), median age 28.5 months (interquartile range [IQR] 16mo) at first assessment and 47 months (IQR 18mo) at last assessment, was assessed half-yearly with the Assisting Hand Assessment (AHA) or the Both Hands Assessment (BoHA) for a total of 329 assessments. Developmental limits and rates were estimated by nonlinear mixed-effects models. Developmental trajectories were compared between levels of manual ability (Mini-Manual Ability Classification System [Mini-MACS] and MACS) and AHA or BoHA performance at 18 months of age (AHA-18/BoHA-18) for both CP subgroups, and additionally between children with bilateral CP with symmetric or asymmetric hand use. **RESULTS:** For both CP subgroups, children classified in Mini-MACS/MACS level I, and those with high AHA-18 or BoHA-18 reached the highest limits of performance. For children with bilateral CP the developmental change was small, and children with symmetric hand use reached the highest limits. **INTERPRETATION:** Mini-MACS/MACS levels and AHA-18 or BoHA-18 distinguished between various developmental trajectories both for children with unilateral and bilateral CP. Children with bilateral CP changed their performance to a smaller extent than children with unilateral CP. **WHAT THIS PAPER ADDS:** Manual Ability Classification System levels and Assisting Hand Assessment/Both Hands Assessment performance at 18 months are important predictors of hand use development in cerebral palsy (CP). Children with bilateral CP improved less than those with unilateral CP. Children with bilateral CP and symmetric hand use reached higher limits than those with asymmetry.

[PMID: 29392717](#)

2. The validity and reliability of the Test of Arm Selective Control for children with cerebral palsy: a prospective cross-sectional study.

Sukal-Moulton T, Gaebler-Spira D, Krosschell KJ.

Dev Med Child Neurol. 2018 Jan 31. doi: 10.1111/dmcn.13671. [Epub ahead of print]

AIM: This study examined the reliability and validity of the Test of Arm Selective Control (TASC) to examine upper extremity selective voluntary motor control in children and adolescents with all types of spastic cerebral palsy (CP). **METHOD:** Fifty-six participants with CP, ranging in age from 5 years 9 months to 18 years 11 months (average 11y 7mo, SD 3y 9mo; 25 males, 31 females), participated in this prospective cross-sectional study. They were evaluated using the TASC and several clinical measures. **RESULTS:** TASC and Manual Ability Classification System ($r=-0.529$, $p<0.001$), TASC and ABILHAND-Kids ($r=0.596$, $p<0.001$), and TASC and affected extremities ($r=-0.486$, $p=0.001$) were moderately correlated. There was a weak correlation between the TASC and Gross Motor Function Classification System ($r=-0.363$, $p=0.006$) and no correlation between the TASC and age ($p=0.366$) or rater ($p=0.713$). Interrater reliability for upper extremity total score (intraclass correlation coefficient [ICC]=0.92-0.94) and upper extremity limb scores (ICC=0.92-0.96) was high for two

independent rater groups ($p \leq 0.001$). Average time to administer was 16 minutes, 18 seconds. INTERPRETATION: The TASC is a reliable and valid tool for objective assessment of selective voluntary motor control. Clinically this measure may guide the selection of medical, surgical, or therapy interventions and may improve outcome prognosis. What this paper adds The Test of Arm Selective Control (TASC) demonstrates a high degree of reliability and multiple aspects of validity when assessing upper extremity selective control in those with cerebral palsy. The TASC is an upper limb companion to the Selective Control Assessment of the Lower Extremity.

[PMID: 29383702](#)

3. Precision grip control while walking down a step in children with unilateral cerebral palsy.

Ebner-Karestinos D, Flament B, Arnould C, Thonnard JL, Bleyenheuft Y.

PLoS One. 2018 Feb 1;13(2):e0191684. doi: 10.1371/journal.pone.0191684. eCollection 2018.

AIM: To compare grip force (GF) and load force (LF) coordination while walking down a step between children with unilateral cerebral palsy (UCP) and typically developing (TD) children. METHODS: Twenty-five children with UCP (age 9.3 ± 1.7 y) and 25 TD controls (age 9.4 ± 2.1 y) walked down a step while holding a grip-lift manipulandum. Dynamic and temporal variables were analyzed. The maximum voluntary contraction (MVC) was also assessed. RESULTS: The temporal course was perturbed mainly in the more affected hand of children with UCP when compared to TD children because the increases in GF and LF onset occurred in a reversed order. Compared with the TD controls, the children with UCP presented higher LF values on both hands and a higher GF on the less affected hand. In children with UCP, the GF to LF adaptation was adequate on the less affected hand but overestimated on the more affected hand. Furthermore, children with UCP presented a lower MVC in the more affected hand, leading to a higher percentage of MVC used during the task. INTERPRETATION: Our findings highlight an anticipatory control of precision grip during a stepping down task in children with UCP that is adequate for the less affected hand but altered for the more affected hand.

[PMID: 29390012](#)

4. Systematic review of high-level mobility training in people with a neurological impairment.

Spencer T, Aldous S, Williams G, Fahey M.

Brain Inj. 2018 Feb 2;1-13. doi: 10.1080/02699052.2018.1429656. [Epub ahead of print]

AIM: The objective of this paper was to systematically review the efficacy of interventions targeting high-level mobility skills in people with a neurological impairment. METHODS: A comprehensive electronic database search was conducted. Study designs were graded using the American Academy of Cerebral Palsy and Developmental Medicine (AAPDM) system and methodological quality was described using the Physiotherapy Evidence Database (PEDro) scale. RESULTS: Twelve exploratory studies (AAPDM levels IV/V), of limited methodological quality (PEDro scores of 2-3 out of 10), were included. Interventions included treadmill training, a three-phase programme, a high-level mobility group, plyometric training, running technique coaching and walk training with blood flow restriction. Diagnoses included acquired brain injury, cerebral palsy, incomplete spinal cord injury and neurofibromatosis type 1. There were difficulties generalizing results from exploratory designs with a broad range of participants, interventions and outcome measures. However, it seems that people with a neurological impairment have the capacity to improve high-level mobility skills, running speed and distance with intervention. There were no adverse events that limited participation. CONCLUSION: There is preliminary evidence to support the efficacy of interventions to improve high-level mobility skills in people with neurological impairments. Well-controlled research with a larger sample is required to provide sufficient evidence to change clinical practice.

[PMID: 29393688](#)

5. Barriers and facilitators to physical activity participation for children with physical disability: comparing and contrasting the views of children, young people, and their clinicians.

Wright A, Roberts R, Bowman G, Crettenden A.

Disabil Rehabil. 2018 Jan 30;1-9. doi: 10.1080/09638288.2018.1432702. [Epub ahead of print]

PURPOSE: Existing research has explored the barriers and facilitators of physical activity participation for young people with disability from the perspective of young people and their families. However, little research has investigated the views of clinicians who facilitate access to physical activity programs and compared this with their child client's perspectives.

METHOD: Interviews were conducted with six allied health and sports development professionals associated with a programme which supports access to recreation and sporting activities. Interviews explored facilitators and barriers to physical activity experienced by their clients. Open-ended survey questions investigating barriers and facilitators of physical activity participation were also completed by 28 young people with disability aged 10-17 years who were clients of this programme. **RESULTS:** The most salient facilitator of participation described by clinicians was "planning programs to promote success and inclusion." Young people described two main facilitators; "the right people make physical activity fun!" and, similar to clinicians, "appropriate and inclusive opportunities to be active." The most salient barriers identified by clinicians were "practical limitations" and "time constraints and priorities," and a novel barrier raised was "whose choice?" The "lack of accessible and inclusive opportunities" was the most pertinent barrier for young people. **CONCLUSIONS:** Clinicians should determine both parent and young person commitment to a physical activity before enrolment. Lack of commitment can act as a barrier to physical activity and a more appropriate intervention could focus on increasing awareness of the benefits of being active, drawing on a Stages of Change based model of service delivery. Implications for rehabilitation Rehabilitation professionals seeking to increase physical activity participation for young people with physical disability should discuss readiness and motivation to change prior to any activity/sports referral. Different behaviour change processes are required for young people and for their parents and both are important to achieve physical activity participation. Regular monitoring is important to identify on-going physical and psychological barriers to participation, even for those who were already active. Clinicians should be aware that teenagers may be more ready to be active as they develop greater independence and should raise awareness of the benefits of physical activity.

[PMID: 29382235](#)

6. Impact of serial gait analyses on long-term outcome of hippotherapy in children and adolescents with cerebral palsy.

Mutoh T, Mutoh T2, Tsubone H, Takada M, Doumura M, Ihara M, Shimomura H, Taki Y, Ihara M.

Complement Ther Clin Pract. 2018 Feb;30:19-23. doi: 10.1016/j.ctcp.2017.11.003. Epub 2017 Nov 8.

The aim of this study was to obtain data of gait parameters on predicting long-term outcome of hippotherapy. In 20 participants (4-19 years; GMFCS levels I to III) with cerebral palsy (CP), gait and balance abilities were examined after 10-m walking test using a portable motion recorder. Hippotherapy was associated with increased Gross Motor Function Measure (GMFM)-66 at 1 year from the baseline ($P < 0.001$). Hippotherapy increased stride length, walking speed, and mean acceleration and decreased horizontal/vertical displacement ratio over time ($P < 0.05$). Stride length and mean acceleration at 6 weeks predicted the elevation of GMFM-66 score. These data suggest that 1-year outcome of hippotherapy on motor and balance functions can be assessed from the early phase by serial monitoring of the gait parameters.

[PMID: 29389473](#)

7. What is the Best Configuration of Wearable Sensors to Measure Spatiotemporal Gait Parameters in Children with Cerebral Palsy?

Carcreff L, Gerber CN, Paraschiv-Ionescu A, De Coulon G, Newman CJ, Armand S, Aminian K.

Sensors (Basel). 2018 Jan 30;18(2). pii: E394. doi: 10.3390/s18020394.

Wearable inertial devices have recently been used to evaluate spatiotemporal parameters of gait in daily life situations. Given the heterogeneity of gait patterns in children with cerebral palsy (CP), the sensor placement and analysis algorithm may influence the validity of the results. This study aimed at comparing the spatiotemporal measurement performances of three wearable configurations defined by different sensor positioning on the lower limbs: (1) shanks and thighs, (2) shanks, and (3) feet. The three configurations were selected based on their potential to be used in daily life for children with CP and typically developing (TD) controls. For each configuration, dedicated gait analysis algorithms were used to detect gait events and compute spatiotemporal parameters. Fifteen children with CP and 11 TD controls were included. Accuracy, precision, and agreement of the three configurations were determined in comparison with an optoelectronic system as a reference. The three configurations were comparable for the evaluation of TD children and children with a low level of disability (CP-GMFCS I) whereas the shank-and-thigh-based configuration was more robust regarding children with a higher level of disability (CP-GMFCS II-III).

[PMID: 29385700](#)

8. Rectus Femoris Transfer Versus Rectus Intramuscular Lengthening for the Treatment of Stiff Knee Gait in Children With Cerebral Palsy.

Ellington MD, Scott AC, Linton J, Sullivan E, Barnes D.

J Pediatr Orthop. 2018 Jan 31. doi: 10.1097/BPO.0000000000001138. [Epub ahead of print]

BACKGROUND: Rectus femoris transfer (RFT) is used to treat stiff knee gait in spastic cerebral palsy. Recently, rectus femoris lengthening has been reported as treatment for stiff knee gait. The purpose of this study was to compare short-term outcomes of 2 surgical procedures. **METHODS:** A retrospective chart review of 23 patients (42 limbs) with diplegic spastic cerebral palsy who had undergone rectus femoris intramuscular lengthening for treatment of stiff knee gait with a Gross Motor Function Classification System level I, II, or III was completed. These patients were matched with a cohort of 23 patients (42 limbs) who had undergone RFTs based on age, sex, Gross Motor Function Classification System level, diagnosis, preoperative Gait Deviation Index, and any simultaneous surgeries. Preoperative and 1 year postoperative motion analysis data and physical examination were compared. **RESULTS:** There were no significant differences in demographics between the groups. On physical examination, a positive postoperative Duncan-Ely test was seen significantly less often in the transfer limbs (20 vs. 37). Average postoperative quad tone score was 1.56 for the transfer group compared with 2.19 for the lengthening group. No significant postoperative difference was seen between groups in stride length, walking speed, cadence, knee flexion at initial contact, peak knee flexion during loading response, mean knee flexion in stance, peak knee flexion in swing, time to peak knee flexion (% swing), time to peak knee flexion (% gait cycle), Gait Deviation Index or total knee range of motion. There was a difference in time to achieve 90 degrees passive knee flexion with the lengthening group reaching this in 8.3 days and transfer group in 15.3 days ($P < 0.0001$). **CONCLUSIONS:** Motion analysis parameters showed results of RFT and rectus femoris intramuscular lengthening to be equivalent 1 year postoperatively. Since rectus femoris lengthening is technically less difficult and rehabilitation faster, rectus femoris lengthening may be preferred if long-term follow-up supports these findings.

[PMID: 29389718](#)

9. Quantitative Assessment of Knee Progression Angle During Gait in Children With Cerebral Palsy.

Dauids JR, Cung NQ, Pomeroy R, Schultz B, Torburn L, Kulkarni VA, Brown S, Bagley AM.

J Pediatr Orthop. 2018 Jan 31. doi: 10.1097/BPO.0000000000001134. [Epub ahead of print]

BACKGROUND: Abnormal hip rotation is a common deviation in children with cerebral palsy (CP). Clinicians typically assess hip rotation during gait by observing the direction that the patella points relative to the path of walking, which is referred to as the knee progression angle (KPA). Two kinematic methods for calculating the KPA are compared with each other. Video-based qualitative assessment of KPA is compared with the quantitative methods to determine reliability and validity. **METHODS:** The KPA was calculated by both direct and indirect methods for 32 typically developing (TD) children and a convenience cohort of 43 children with hemiplegic type CP. An additional convenience cohort of 26 children with hemiplegic type CP was selected for qualitative assessment of KPA, performed by 3 experienced clinicians, using 3 categories (internal, >10 degrees; neutral, -10 to 10 degrees; and external, >-10 degrees). **RESULTS:** Root mean square (RMS) analysis comparing the direct and indirect KPAs was 1.14 ± 0.43 degrees for TD children, and 1.75 ± 1.54 degrees for the affected side of children with CP. The difference in RMS among the 2 groups was statistically, but not clinically, significant ($P = 0.019$). Intraclass correlation coefficient revealed excellent agreement between the direct and indirect methods of KPA for TD and CP children (0.996 and 0.992, respectively; $P < 0.001$). For the qualitative assessment of KPA there was complete agreement among all examiners for 17 of 26 cases (65%). Direct KPA matched for 49 of 78 observations (63%) and indirect KPA matched for 52 of 78 observations (67%). **CONCLUSIONS:** The RMS analysis of direct and indirect methods for KPA was statistically but not clinically significant, which supports the use of either method based upon availability. Video-based qualitative assessment of KPA showed moderate reliability and validity. The differences between observed and calculated KPA indicate the need for caution when relying on visual assessments for clinical interpretation, and demonstrate the value of adding KPA calculation to standard kinematic analysis.

[PMID: 29389721](#)

10. Determinants of muscle preservation in individuals with cerebral palsy across the lifespan: a narrative review of the literature.

Verschuren O, Smorenburg ARP, Luiking Y, Bell K, Barber L, Peterson MD.

J Cachexia Sarcopenia Muscle. 2018 Feb 2. doi: 10.1002/jcsm.12287. [Epub ahead of print]

In individuals with cerebral palsy (CP), smaller muscle and atrophy are present at young age. Many people with CP also experience a decline in gross motor function as they age, which might be explained by the loss of muscle mass. The clinical observation of muscle wasting has prompted a comparison with sarcopenia in older adults, and the term accelerated

musculoskeletal ageing is often used to describe the hallmark phenotype of CP through the lifespan. However, there has been very little research emphasis on the natural history of ageing with CP and even less with respect to the determinants or prevention of muscle loss with CP. Considering the burgeoning interest in the science of muscle preservation, this paper aims to (i) describe the characteristics of accelerated musculoskeletal ageing in people with CP, (ii) describe the pathophysiology of sarcopenia and parallels with CP, and (iii) discuss possible therapeutic approaches, based on established approaches for sarcopenia.

[PMID: 29392922](#)

11. The effect of a practical nutrition education programme on feeding skills of caregivers of children with cerebral palsy at Muhimbili National Hospital, in Tanzania.

Mlinda SJ, Leyna GH, Massawe A.

Child Care Health Dev. 2018 Jan 30. doi: 10.1111/cch.12553. [Epub ahead of print]

BACKGROUND: Feeding children with cerebral palsy (CP) is challenging and can lead to poor health outcomes. Using a facility-based intervention, we assessed the effect of a practical nutrition programme on feeding skills in caregivers of children with CP attending a pediatric clinic in urban Tanzania. **METHODS:** A randomized-controlled intervention study, involving 2-block stratified sample of under-5 CP children attending a specialized pediatric clinic at the Muhimbili National Hospital was done. One hundred ten moderate-to-severe, new and follow-up cases of children with CP were randomly allocated to the intervention (N = 63) and control groups (N = 47). A short nutrition education on feeding and positioning skills was provided to caregivers and occupational therapy sessions to CP children. Bivariate and multivariable logistic regression analyses of collected data were done. Statistical significance was assessed at $p < .05$. **FINDINGS:** The intervention significantly improved feeding skills of caregiver in the select indicators assessed. More caregivers appropriately positioned the children (AOR = 5.29; 95% CI: 2.00-13.96), fed children slowly (AOR: 5.17, 95% CI: 1.99-13.44), and involved the child during the feeding process (AOR = 3.46; 95% CI: 1.42-8.44). During feeding, caregiver's reported being less stressed (AOR = 2.53, 95% CI: 1.04-6.13) and the child's mood was more likely to be reported as improved (AOR = 3.15, 95% CI: 1.33-7.474). Although changes were observed in oral motor feeding skills (AOR = 1.67; 95% CI: 0.72-3.91) and functional feeding skills (AOR = 2.28; 95% CI: 0.86-6.06), they did not reach statistical significance in the multivariable models. **CONCLUSION:** Strengthening nutrition education and services for caregivers of children with CP has great value in the care of children with special needs and may improve the health outcomes of children as well as reduce stress among parents/caregivers.

[PMID: 29383754](#)

12. Time burden of caring and depression among parents of individuals with cerebral palsy.

Park EY, Nam SJ.

Disabil Rehabil. 2018 Jan 30:1-6. doi: 10.1080/09638288.2018.1432705. [Epub ahead of print]

PURPOSE: The presence of an individual with disability in a family affects the whole family. Families of individuals with cerebral palsy (CP) experience increased psychological anxiety and financial problems; specifically, parents tend to feel time pressure and struggle to maintain their social and cultural activities. **METHODS:** t-Tests and ANOVA with post hoc Tukey tests were used to compare caregiving time, time pressure, and depression between parents. Multivariate logistic regression analysis was used to examine the effect of caregiving time and time pressure on depression in parents. **RESULTS:** Regarding depression, 58 (38.2%) respondents scored ≥ 16 on the Center for Epidemiological Studies - Depression scale. Respondents supporting a preschool child spent more time than those supporting adults did; those supporting adults reported less time pressure than those supporting individuals of other ages. Caregiving time's effect on depression was not supported, whereas increased time pressure raised the risk of depression. **CONCLUSIONS:** The frequency of depression among parents supporting individuals with CP exceeded preceding findings. Time pressure due to support appears to directly predict depression. Total time spent caring appears unrelated to depression. Implications for Rehabilitation It is necessary to prepare various community and family support systems in order to relieve parental caregivers' burden and exhaustion. Interventions should focus on parents with higher time pressure than parents with high caregiving time. Physical and psychological difficulties experienced by parents supporting a child with a disability vary with the child's life stage, meaning that families' care burden partly depends on the age of the individual with disabilities.

[PMID: 29378440](#)

13. Are the health needs of young people with cerebral palsy met during transition from child to adult health care?

Solanke F, Colver A, McConachie H; Transition collaborative group.

Child Care Health Dev. 2018 Jan 28. doi: 10.1111/cch.12549. [Epub ahead of print]

BACKGROUND: The transition from child to adult health care is a particular challenge for young people with cerebral palsy, who have a range of needs. The measurement of reported needs, and in particular unmet needs, is one means to assess the effectiveness of services. **METHODS:** We recruited 106 young people with cerebral palsy, before transfer from child services, along with their parents to a 3-year longitudinal study. Reported needs were measured with an 11-item questionnaire covering speech, mobility, positioning, equipment, pain, epilepsy, weight, control of movement, bone or joint problems, curvature of the back, and eyesight. Categorical principal component analysis was used to create factor scores for bivariate and regression analyses. **RESULTS:** A high level of reported needs was identified particularly for control of movement, mobility, and equipment, but these areas were generally being addressed by services. The highest areas of unmet needs were for management of pain, bone or joint problems, and speech. Analysis of unmet needs yielded two factor scores, daily living health care and medical care. Unmet needs in daily living health care were related to severity of motor impairment and to attending nonspecialist education. Unmet needs tended to increase over time but were not significantly ($p > .05$) related to whether the young person had transferred from child services. **CONCLUSIONS:** Reporting of unmet needs can indicate where service development is required, and we have shown that the approach to measurement can be improved. As the number of unmet health needs at the start of transition is considerable, unmet health needs after transition cannot all be attributed to poor transitional health care. The range and continuation of needs of young people with cerebral palsy argue for close liaison between adult services and child services and creation of models of practice to improve coordination.

[PMID: 29377236](#)

Prevention and Cure

14. Neuroprotective effect of Sirt2-specific inhibitor AK-7 against acute cerebral ischemia is P38 activation-dependent in mice.

Wu D, Lu W, Wei Z, Xu M, Liu X.

Neuroscience. 2018 Jan 27. pii: S0306-4522(18)30070-8. doi: 10.1016/j.neuroscience.2018.01.040. [Epub ahead of print]

Cerebral ischemic is the most common cause of stroke with high morbidity, disability and mortality. Sirtuin-2 (Sirt2), a vitally important NAD⁺-dependent deacetylase which has been widely researched in central nervous system diseases, has also been identified as a promising treatment target by using its specific inhibitors such as AK-7. In this study, we found that P38 was specifically activated after focal cerebral ischemia injury, and it was also significantly activated after AK-7 administration in a concentration-dependent manner in vitro and in vivo. AK-7 decreased the infarction volume remarkably and promoted the recovery of neurological function efficiently in the mice evaluated by behavior tests. In contrast, pP38 inhibition increased the infarct volume and exacerbated the symptoms of paralysis. Herein, we suggest AK-7 improves the outcome of brain ischemia in dependence on the P38 activation in mice, which may serve as a strategy for the treatment of stroke.

[PMID: 29382550](#)