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Health, Wellness, and the Pursuit of Happiness: Common Ground for Adults with Cerebral Palsy and Modern Physical Therapists

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Abstracts* of Platform Presentations at the 2014 Combined Sections Meeting

■ PLATFORM ABSTRACTS

PARTICIPATION OUTCOMES OF A GROUP THERAPY PROGRAM FOR CHILDREN WITH MOTOR COORDINATION DEFICITS

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PURPOSE/HYPOTHESIS: Children who exhibit characteristics consistent with Developmental Coordination Disorder (DCD) demonstrate impairments in endurance, balance, coordination, and social skills limiting their participation in physical activity with their peers. Recent evidence has supported therapeutic intervention for children with DCD using body function and task oriented approaches. Despite a growing body of literature on therapeutic methods, there is limited evidence about the most effective mode of intervention for children with DCD: individual or group. The purpose of this quasi-experimental pilot study was to examine the feasibility and outcomes of a group therapy program for children with motor coordination deficits.

NUMBER OF SUBJECTS: Four children, ages 6-9, who met the diagnostic criteria for DCD, participated in this study. Participants scored \leq 5th percentile on the Movement Assessment Battery for Children-2nd Edition and met all other inclusionary criteria. All participants were able to walk independently without an assistive device and run short distances unaided. One child dropped out after two sessions.

MATERIALS/METHODS: Participants attended two-90 minute group sessions for 9 weeks, and one-90 minute group session for 2 weeks. The therapy program consisted of strength, balance, coordination, and endurance activities. Motor control and cognitive strategies were used to teach sports specific skills and provide feedback to participants.

RESULTS: Participants ($n = 3$) exhibited increased scores on the Bruininks-Oseretsky Test of Motor Proficiency- Second Edition (BOT-2) Bilateral

Coordination subtest. Two of the participants exhibited increased scores on the BOT-2 Strength subtest. Participants also demonstrated an increase of three levels on the Goal Attainment Scale (GAS). Parents reported improved endurance, confidence, and social engagement at the end of the group therapy program. Parents also identified increased spontaneous initiation of and engagement in physical activities that were perceived as enjoyable by both the child and family.

CONCLUSIONS: Group therapy may be an effective mode of providing body function and task oriented interventions for children with developmental coordination deficits. The group therapy environment afforded the children opportunities for role modeling, social engagement, and positive peer reinforcement of motor successes that are not available in traditional one on one therapy sessions. Further research in this area is needed.

CLINICAL RELEVANCE: Children with motor coordination problems with and without the diagnosis of Developmental Coordination Disorder are a growing population in pediatric physical therapy environments. Research shows that children with DCD continue to exhibit coordination difficulties and a resulting poorer quality of life than their same-aged peers as they move into adulthood. Therapeutic interventions that address not only the physical impairments of children with DCD, but also their psychosocial function are necessary to improve participation throughout the lifespan.

THE EFFECT OF PARTICIPATION IN AN INTENSIVE SPORTS PROGRAM ON WALKING FUNCTION AND ENDURANCE IN CHILDREN WITH CEREBRAL PALSY

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PURPOSE/HYPOTHESIS: It is important that children with cerebral palsy (CP) maintain a high level of physical

*Abstracts are presented in alphabetical order of the first author's last name.

fitness similar to typically developing children to avoid the natural functional decline that occurs with age in this population. By participating in sports programs developed specifically for children with CP, individuals are given an opportunity to be physically active which may improve their level of fitness and functional ability. The purpose of this study was to determine the effect of participation in sports programs on walking function and endurance.

NUMBER OF SUBJECTS: This was a retrospective analysis of children with CP ages 6-20 years who participated in a local sports program from spring 2004 to summer 2012. There were 519 participants in the programs. Of these, 326 participants (mean age 11.5 ± 3.2 years) had pre and post data recorded. The 326 participants consisted of a total of 109 children, many of whom attended multiple programs throughout the years.

MATERIALS/METHODS: Children attended programs in the spring, summer and fall. Summer programs ($n = 269$) were held 5 days/week for a total of 4 weeks. Spring and fall basketball programs ($n = 57$) were held 1 night/week for 8 weeks. Outcome measures: Timed Up and Go (TUG), modified 6-minute walk (6MW, children were allowed to run), and 25-foot walk/run. Data Analysis: Data was analyzed separately for summer and spring/fall programs. A repeated measures ANOVA, using Gross Motor Function Classification System (GMFCS) as a between subjects factor was conducted. Post-hoc analysis included Dunnett's T3 and paired t-tests. A Pearson correlation coefficient was performed on the complete data set to determine the relationship between the number of weeks attended by a single participant and their change score over time.

RESULTS: Summer: There was a significant main effect for the TUG ($p = .025$) and modified 6MW ($p < .001$) but no significant interaction with GMFCS level. Post-hoc analysis revealed that GMFCS level III made the most significant gains. There was no significant change in 25-foot walk/run. Spring/Fall basketball: There was no significant change in any of the outcome measures.

Correlation: A mild significant correlation was found between the modified 6MW change and total weeks attended ($r = .24$, $p = .014$).

CONCLUSIONS: Significant differences found in the TUG and modified 6MW during summer programs indicate that walking function and endurance improved as a result of attending intensive sports programs. The less intensive basketball programs did not show significant changes. Higher frequency of program attendance may be related to improvements in endurance over time in children with CP.

CLINICAL RELEVANCE: Participation in intensive sports programs is beneficial for children with CP. Dosing of activity is clearly important as less intensive sports programs did not show improvements. However, overall program attendance, including less intensive basketball programs, appeared to be related to improvements in endurance and potential long term benefits in children with CP.

HEALTH, WELLNESS, AND THE PURSUIT OF HAPPINESS: COMMON GROUND FOR ADULTS WITH CEREBRAL PALSY AND MODERN PHYSICAL THERAPISTS

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PURPOSE/HYPOTHESIS: Health, wellness, and happiness are important long-term goals for adulthood, especially for children with cerebral palsy (CP). Physical therapists (PTs) can assist individuals with CP realize these goals; however it requires PTs to have a greater understanding of how to apply impairment, functional, or contextual interventions to meet these goals. A critical gap in knowledge exists about perceptions of happiness and health priorities of adults with CP. The purpose of this paper is to describe the beliefs, feelings, and perceptions of happiness and health of adults with CP as compared to adults without CP, specifically PTs.

NUMBER OF SUBJECTS: Participants included 19 adults with CP (mean age 47 years; 14 = females Gross Motor Functional Classification System level II = 7, III = 4, IV = 2, V = 6; median income = \$50,000-\$100,000; median education = Master's Degree) and 16 PTs (mean age 50 years, 12 = females; median income = \$50,000-\$100,000; median education = Master's Degree) from the Northeast ($n = 17$), South ($n = 7$), West ($n = 5$), and Midwest ($n = 5$) regions of the US.

MATERIALS/METHODS: Phenomenology, the study of shared meanings of experience of phenomena, was the qualitative method of inquiry. Open ended and semi-structured questions were used to elicit participants' beliefs, perceptions, and feelings associated with happiness and health. The Oxford Happiness Questionnaire, the Satisfaction with Life Scale, the Center for Epidemiologic Studies Depression Scale, and demographic questions documented participant characteristics.

RESULTS: Both groups had similar levels of life satisfaction, happiness, and depression on standardized assessments. Recurring themes included: having meaning or a purpose in life—"doing something to make a difference in someone else's life"—and doing something that makes you feel good—vacations, art, outdoor activities, or listening to music. Adults with CP identified "attitudes" and "communication difficulties" as barriers. In both groups, most reported they felt able to manage weight status, cardiac health, and bone density, but most did not report corresponding fitness and lifestyle behaviors. Adults with CP had a higher frequency of health problems, such as diabetes or high cholesterol. In both groups, few utilized PTs to meet health goals.

CONCLUSIONS: Adults with CP and PTs share similar meanings of happiness despite differences in physical abilities. Happiness was defined by the ability to feel good

and find purpose. Performing regular preventative health behaviors is an area both groups of adults reported as requiring improvement.

CLINICAL RELEVANCE: Life experiences of adults with CP that include themes of happiness and health are important stories to share for inspiration and modeling of positive behavior. Promoting positive outcomes can be enhanced by patient-centered care plans that tap into personal motivations, values, and interests. Managing weight status, cardiac health, and bone density are health concerns for all adults and PTs can foster partnerships with adults with CP to meet these goals.

DETERMINANTS OF SELF-DETERMINED BEHAVIORS OF YOUNG CHILDREN WITH CEREBRAL PALSY

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PURPOSE/HYPOTHESIS: To identify the child and family characteristics that together are determinants of self-determined behaviors of young children with cerebral palsy (CP).

NUMBER OF SUBJECTS: 429 children (18 to 60 months, 56% boy) and their parents (92% mother). The participants were grouped by gross motor function level, i.e., walking mobility (Gross Motor Function Classification System, GMFCS levels I-II) and limited mobility (GMFCS levels III-V).

MATERIALS/METHODS: Parents completed the Early Coping Inventory, Health Conditions for Children with CP, Family Expectation of Child, and Family Support to Child. Adaptive Behavior Index, measured by Early Coping Inventory, was used to represent self-determined behaviors because we believe that adaptive behaviors reflect the concepts of self-determined behaviors of young children. Therapists scored the Test of Playfulness during observation of play and classified children's GMFCS levels. Structural equation modeling was used to test two models of child and family determinants of self-determined behaviors, one for children with walking mobility and the other for children with limited mobility.

RESULTS: Fit statistics indicated a good fit between the data and each model. Cognitive-behavioral problems (cognition, communication, and emotional/behavioral problem; $\beta = -.66, p < .05$) and the extent family supports their child's self-determined behaviors ($\beta = .26, p < .05$) explained 60% of the variance in self-determined behaviors of children with walking mobility.

Cognitive-behavioral problems ($\beta = -.54, p < .05$), playfulness, and the extent family supports their child's self-determined behaviors ($\beta = .16, p < .05$) explained 68% of the variance in self-determined behaviors of children with limited mobility. The less the child's cognitive-behavioral problems affect daily activities and

the more the extent family supports their child's self-determined behaviors (the more effective the child's self-determined behaviors. Playfulness only had an effect on self-determined behaviors of children with limited mobility ($\beta = .29, p < .05$).

CONCLUSIONS: Cognition, communication, emotional/behavioral regulation, and the extent family supports their child's self-determined behaviors were determinants of self-determined behaviors of young children with CP. Playfulness also was a determinant for children with limited mobility.

CLINICAL RELEVANCE: Self-determined behaviors of young children with CP are influenced by child and family characteristics. Service providers are encouraged to assess children's self-determined behaviors during daily activities in order to build on strengths and identify areas for improvement. This might include supporting the child's efforts to initiate communication, problem-solve, express preferences, regulate emotions, interact with children, and try new activities. Supporting playfulness may be an important strategy to promote self-determined behaviors of children with CP with limited mobility.

IMPAIRED PERFORMANCE DURING THE MOBILE PARADIGM IN INFANTS WITH COMPLEX CONGENITAL HEART DEFECTS AT THREE MONTHS

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PURPOSE/HYPOTHESIS: Advances in surgical procedures for infants with complex congenital heart defects (CCHD), such as left hypoplastic heart syndrome, have resulted in decreased mortality in an otherwise fatal heart defect. The first infants to receive such surgical procedures are now in their thirties. The scientific and clinical focus for this population has been lifesaving surgical techniques. Currently, most of these infants survive surgery, and there is some evidence that their neurodevelopmental, especially motor and cognitive skills, are delayed at school age. Motor and cognitive performance during infancy in infants with CCHD is unknown. Therefore, the purpose of this study is to examine motor and learning performance of infants with CCHD with the mobile paradigm.

NUMBER OF SUBJECTS: Four infants with CCHD and five infants with typical development (TD) completed this project at three months of age to date.

MATERIALS/METHODS: The 15 minutes mobile paradigm task is used to evaluate infantile learning (Day 1) and short-term memory 24 hours later (Day 2). A cause-and-effect paradigm with standard periods of baseline, acquisition and extinction the infants' right leg is tethered to the mobile so that during acquisition the mobile moves in proportion to the infants' kicks. Learning is operationally defined as an increased kicking number

during the extinction period of Day 1; and short-term memory as increased kicking during baseline of Day 2. **RESULTS:** Infants with CCHD kicked more per minute (7.2 ± 4.3) compared with infants with TD (1.7 ± 1.0). On Day 1, infants with CCHD showed 1.9 times and 1.8 times more kicks during acquisition and extinction periods than baseline period and infants with TD showed 5.3 and 6.1 times more kicks during acquisition and extinction periods. On Day 2, Infants with CCHD showed 1.2 times more kicks whereas infants with TD showed 9.5 times more kicks during baseline.

CONCLUSIONS: Both the CCHD and TD groups kicked more during acquisition but the TD group outperformed the CCHD group during extinction, the test of learning. Only infants with TD increased their kicking number during baseline Day 2. Taken together, these results suggest that infants with CCHD kicked more during baseline and showed learning and short-term memory difference from infants with TD.

CLINICAL RELEVANCE: Infants with CCHD may demonstrate delays in motor and cognitive development during early infancy. Interestingly their performance in the mobile paradigm is similar to infants born preterm. Motor and cognitive delays may be easily identifiable in this population. Pediatric physical therapy is suggested to support and improve the neurodevelopment of this high-risk population.

EASE OF CAREGIVING OF CHILDREN: A MEASURE OF PARENT PERCEPTIONS OF THE PHYSICAL DEMANDS OF CAREGIVING FOR YOUNG CHILDREN WITH CEREBRAL PALSY

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PURPOSE/HYPOTHESIS: The purpose of this study was to determine the psychometric properties of the Ease of Caregiving of Children measure. Specific objectives were to: 1) determine the reliability of the measure, 2) compare ease of caregiving for young children with cerebral palsy (CP) to peers without CP (construct validity), and 3) determine the difficulty of items for young children with CP to create an interval-level measure.

NUMBER OF SUBJECTS: 429 parents of children with CP and 110 parents of children without CP participated in this study.

MATERIALS/METHODS: Parents of children with CP completed the Ease of Caregiving of Children measure and therapists determined children's Gross Motor Function Classification System (GMFCS) levels during an evaluation session. Parents of children without CP completed the Ease of Caregiving of Children measure through distribution of paper questionnaire packets. For

the reliability portion of the study, a sub-set of 33 parents of children with CP repeated the Ease of Caregiving of Children measure via a phone interview with a researcher an average of 23 days after the first assessment. Construct validity, known groups method, was determined through two-way Analyses of Variances, examining the effects of four motor function levels (without CP, GMFCS level I, GMFCS levels II & III, and GMFCS levels IV & V) and three age groups (17-30, 31-42, and 43-60 months). Rasch analysis was used to create an interval-level measure.

RESULTS: The children ranged in age from 18 to 60 months (mean age 38mo, SD 11mo). Children's motor abilities varied: GMFCS I (n = 154), GMFCS II/III (n = 102), and GMFCS IV/V (n = 173). Caregivers were predominately mothers (92%) who had a mean age of 34 years (SD 6.9). Internal consistency of the Ease of Caregiving measure was high (Cronbach's alpha = 0.92). Test-retest reliability was acceptable [ICC(2,1) = 0.76 (95%CI: 0.56-0.87)]. Ease of caregiving varied by age for children without CP. Parents of children older than 42 months had higher ease of caregiving than children younger than 31 months ($p < .001$). There was no significant difference by age for children with CP. Ease of caregiving was significantly different between all motor ability levels ($p < 0.001$), with children with higher motor ability having higher ease of caregiving. Rasch analysis for children with CP resulted in a hierarchical ordering of items with good fit and logical ordering. The item separation was 9.84. Item misfit values ranged from .75 to 1.7, with only one item, helping a child to drink, greater than 1.5. All of the items except for assisting a child to eat displayed differential item functioning among the GMFCS levels.

CONCLUSIONS: Findings support the Ease of Caregiving of Children as a valid and reliable tool to measure parents' perception of their difficulty to safely assist their child to perform activities of daily living.

CLINICAL RELEVANCE: A reliable and valid measure of ease of caregiving will enable health care providers to assess and meet families' needs in caring for their children with CP.

RELIABILITY AND DIAGNOSTIC ACCURACY OF CLINICAL TESTS OF VESTIBULAR FUNCTION FOR CHILDREN

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PURPOSE/HYPOTHESIS: Increasing reports of children with vestibular dysfunction warrant development of simple, inexpensive clinical tests of vestibular function. The purpose of this study was to determine reliability, diagnostic values, cut-off scores and minimal detectable

change scores of clinical tests of vestibular function for children.

NUMBER OF SUBJECTS: 20 children with severe to profound bilateral sensorineural hearing loss (SNHL), mean age = 8.9 (SD = 1.8) years and 18 children with typical development (TD), mean age = 9.4 (SD = 2.8) years participated.

MATERIALS/METHODS: Clinical tests were completed twice, 4 hours to 7 days apart for reliability, and included: 1) Head Thrust Test (HTT: corrective saccades were observed as the subject attempted to keep eyes focused on a target as the head was quickly turned right/left), 2) modified Emory Clinical Vestibular Chair Test (m-ECVCT: time in seconds of nystagmus with fixation removed by infrared camera goggles following 30 second rotations to the right and left at 0.5 Hz), 3) Dynamic Visual Acuity (DVA: acuity difference with the head still and passively moved at 2 Hz), 4) Modified Clinical Test of Sensory Interaction on Balance (MCTSIB: time in seconds to stand on the floor/foam with eyes opened/closed), 5) Sensory Organization Test Vestibular Ratio (SOT-VR: sway score of condition 5, eyes closed on sway referenced platform, divided by sway score of condition 1, eyes opened on stable platform). Diagnosis was determined with gold standard tests including rotary chair (i.e. measured the vestibulo-ocular reflex) and vestibular evoked myogenic potential (i.e. measured saccular function). Reliability was calculated with Intraclass Correlation Coefficient (ICC). Area under the receiver operating curve (AUC), cut-off scores, sensitivity, specificity, predictive values and minimal detectable change scores (MDC90) were calculated.

RESULTS: Test-retest reliability of clinical tests (n = 38) ranged from ICC = 0.73-0.95. 19 children with SNHL and 2 with TD received clinical and gold standard tests for diagnostic ratios. Eight children with SNHL had hypofunction. Sensitivity, specificity and predictive values ranged from 63-100% using the following cut-off scores which represented the largest AUC: 1) HTT > 1 corrective saccade to right and/or left head thrusts, 2) SOT-VR < 0.20; 3) MCTSIB < 110 seconds (max = 120 sec); 4) DVA > 10 optotypes; 5) m-ECVCT < 29.2 seconds. MDC90 for DVA and MCTSIB were 8 optotypes and 16.75 seconds, respectively.

CONCLUSIONS: Clinical tests had good reliability and ability to screen for vestibular hypofunction with > 75% accuracy.

CLINICAL RELEVANCE: This study provides tools for pediatric physical therapists to screen for vestibular hypofunction. The tests are easy to complete and do not require expensive equipment. The best tests to determine whether a child with an otherwise normal neurological system has vestibular hypofunction include: 1) HTT, 2) m-ECVCT fixation removed, 3) DVA, 4) MCTSIB and 5) SOT-VR. MDC90 scores should be considered if using the DVA and MCTSIB as outcome tools to detect improvement due to intervention.

ASSESSMENT OF THE CONTRALESIONAL CORTICOSPINAL TRACT IN EARLY-ONSET PEDIATRIC HEMIPLEGIA

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PURPOSE/HYPOTHESIS: While pediatric hemiplegia results from a unilateral lesion, the immature state of the brain at the time of injury increases the likelihood of observing changes in the non-lesioned hemisphere as well. When a lesion occurs early in life, it is possible to utilize direct ipsilateral corticospinal projections from the non-lesioned hemisphere, thus preserving and strengthening these pathways to a greater extent than in a typically developing child. The purpose of this preliminary study was to use diffusion tensor imaging to evaluate the contralesional corticospinal tracts in individuals with early-onset pediatric hemiplegia. We hypothesized we would observe increases in volume and fractional anisotropy representing increased use of the non-lesioned hemisphere to control movements of both the non-paretic and paretic limbs.

NUMBER OF SUBJECTS: 12 individuals with pediatric hemiplegia from a pre- or perinatally acquired unilateral lesion and 11 typically-developing age-matched control subjects.

MATERIALS/METHODS: Diffusion tensor images were acquired for all subjects using a 3 T scanner with 60 diffusion directions and isotropic voxel dimensions of 2 mm. Probabilistic tractography was conducted from the cerebral peduncles to the posterior limb of the internal capsule to reconstruct a portion of the corticospinal tracts on both the lesioned and non-lesioned sides. The average fractional anisotropy, mean diffusivity, axial diffusivity, radial diffusivity, and volume were then calculated. Each metric was compared between the contralesional tract and dominant tract in control subjects using Fisher's LSD t-tests to correct for multiple comparisons.

RESULTS: The contralesional (non-lesioned) tract was found to have significantly decreased values for fractional anisotropy and increased values for radial diffusivity relative to control subjects. The volume of the tracts was increased on the contralesional side relative to controls.

CONCLUSIONS: The increase in volume on the contralesional side supports our hypothesis and suggests an increased use of ipsilateral corticospinal projections in early-onset pediatric hemiplegia that are largely reduced during typical development. However, the integrity of the contralesional corticospinal tracts was reduced, likely due to an overall decrease in use of either upper extremity relative to typically developing children.

CLINICAL RELEVANCE: Children with early-onset pediatric hemiplegia have difficulty with bimanual tasks, which may be due to additional deficits in their non-paretic limb, as well as an inability to suppress mirror movements in order to independently control both upper extremities. This study suggests that there is an increased use of the non-lesioned hemisphere to control both upper extremities, which would result in mirror

movements and impaired bimanual coordination. Additionally, the decreased integrity measures in the contralesional tract could contribute to impairments in the non-paretic upper extremity.

COMPARISONS OF PHYSICAL PERFORMANCE MEASURES IN YOUNG CHILDREN BASED ON BODY MASS INDEX CATEGORIES

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PURPOSE/HYPOTHESIS: In the past 30 years, the prevalence of obesity in U.S. children ages 6-11 yr has quadrupled. Research on the effect of obesity in young children (≤ 9 yr) is limited. The primary objective of this study was to determine the differences in gait, balance and muscle strength in young children (5-9 yr) based on their body mass index (BMI).

NUMBER OF SUBJECTS: 145 children (5-9 yr) participated in this cross sectional design study. Based on international BMI percentile cut-offs, participants were classified into 3 groups: non-overweight (NW, $n = 83$, 7.3 ± 1.3 yr), overweight (OW, $n = 30$, 7.7 ± 1.3 yr) and obese (OB, $n = 32$, 7.4 ± 1.3 yr).

MATERIALS/METHODS: Gait data were collected at a self-selected walking speed using the GAITRite system. Balance was assessed using an AMTI (Advanced Mechanical Technology Inc., Watertown, MA) force platform during quiet bipedal stance with eyes open (EO)/eyes closed (EC) and tandem stance with EO/EC conditions. Center of pressure parameters calculated included: average velocity (Vavg), maximum velocity in medial-lateral (VML) and anterior-posterior directions and sway area. Hand grip strength was determined with a handgrip dynamometer. Leg strength/power was evaluated with vertical jump (VJ) height using a Just Jump mat. Data were analyzed with a one-way ANOVA with Bonferroni's post hoc test ($P \leq 0.05$).

RESULTS: Compared to the NW group, children in the OB group walked with a significantly wider base of support (NW: 7.4 ± 3.2 cm vs. OB: 9.5 ± 3.1 cm, $P = 0.001$), less single support time (NW: $42.3 \pm 2.0\%$ vs. OB: $41.1 \pm 1.6\%$, $P = 0.016$) and more double support time (NW: $16.3 \pm 3.1\%$ vs. OB: $17.9 \pm 3.0\%$, $P = 0.04$). Significant differences were noted for Vavg as follows: bipedal EO (NW vs. OW: $P = 0.004$; NW vs. OB: $P = 0.000$), bipedal EC (NW vs. OW: $P < 0.013$; NW vs. OB: $P = 0.000$) and tandem EO (NW vs. OW: $P = 0.003$; NW vs. OB: $P = 0.000$). Also, VML was significantly different between the NW and OB groups in the bipedal EO ($P = 0.000$) and bipedal EC ($P = 0.002$) conditions. Being OW or OB resulted in significantly poor VJ height compared to being NW (NW: 29.4 ± 6.0 cm vs. OW: 26.2 ± 3.7 cm, $P = 0.02$; NW vs. OB: 25.2 ± 4.7 cm, $P = 0.001$). The OB group had greater handgrip strength compared to their peers in the NW group for the dominant (NW: 10.9 ± 3.8 kg vs. OB: 12.8 ± 3.7 kg, $P = 0.03$) and non-dominant

limbs (NW: 9.8 ± 3.3 kg vs. OB: 12.1 ± 3.7 kg, $P = 0.03$). No significant differences were observed between the OW and OB categories.

CONCLUSIONS: Our findings suggest that differences primarily existed in young children between the NW and OB categories for base of support, single and double limb stance time during walking, and hand grip strength. Also, children in the OW and OB groups had decreased measures of velocity during postural balance and VJ height when compared to their NW counterparts.

CLINICAL RELEVANCE: This information is important for physical therapists to consider when designing fitness programs that will allow safe and successful participation for children who are overweight and obese.

INFANTS AT HIGH RISK OF AUTISM SHOW DELAYED MOTOR DEVELOPMENT WHEN COMPARED TO TYPICALLY DEVELOPING INFANTS

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PURPOSE/HYPOTHESIS: Siblings of children with autism have an increased risk of developing autism. Autism risk for the general population is 1 in 53, but for siblings of a child with autism, the risk is increased to 1 in 4. Autism is characterized by delays and disability in cognitive, social, emotional, and language domains. Currently, there are no tools available to diagnosis autism before 1 year of age, and the vast majority of children do not receive a diagnosis before 3 years. In the absence of an autism diagnosis these infants are also at higher risk for global language delay and poor performance on cognitive task. The motor domain may offer some insight into assessment of this high-risk population during infancy.

NUMBER OF SUBJECTS: 39 infants participated in this study; 15 typically-developing (TD) and 24 at higher-risk of Autism (AR) due to an older sibling with the diagnosis. In this longitudinal study, infants were seen at 2, 4, and 6 months of age as part of a larger study on early signs of autism.

MATERIALS/METHODS: Infants were videotaped in their homes using a standardized protocol. Infants were placed in various positions and shown developmentally appropriate toys. For this project, videos were viewed retrospectively and infants scored by a blinded research assistant for items on the Alberta Infant Motor Scale (AIMS) to assess motor skill development with a standardized tool.

RESULTS: A 2 (group) x 3 (visit) repeated measures ANOVA revealed a main effect for visit (10.4 , $p = .011$) and main effect for group (5.7 , $p = .041$) suggesting that both groups improved overtime, with the TD group outperforming the AR group. Post hoc testing revealed that the TD group had significantly higher AIMS percentile than AR group; 14% and 13% higher at 4 and 6 months of age respectively. No significant difference at 2 months.

CONCLUSIONS: The conclusions are twofold: 1) infants at a higher AR may have a different developmental trajectory of motor skill development on the AIMS from 2 – 6 months of age, and 2) important time periods to identify such delay may be as early as four and six months of age.

CLINICAL RELEVANCE: Infants with AR may show detectable differences in motor performance on the AIMS. None of these infants were receiving supportive services, including physical therapy, for motor delay. Earlier intervention in the first few months of life may be one of the best opportunities to train infants and parents on early skill development before major delays in social and cognitive skills are typically identified. A multidisciplinary approach can be initiated with a focus on meeting the age-appropriate needs of the child.

THE USE OF SIMULTANEOUS VISUAL AND PROPRIOCEPTIVE FEEDBACK FOR IMPROVING LOCOMOTOR SYMMETRY IN ADULTS WITH CEREBRAL PALSY

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PURPOSE/HYPOTHESIS: Gait symmetry is important for energy efficiency, gait speed, and balance control, and may decrease the risk of falls and musculoskeletal injury. The purpose of this study was to gather preliminary evidence that the addition of visual and proprioceptive real time feedback regarding spatiotemporal asymmetry of gait during training would improve gait symmetry, speed, and endurance, and dynamic balance in adults with cerebral palsy (CP).

NUMBER OF SUBJECTS: Five male subjects, 25-69 yrs (avg = 39), with CP (GMFSC I&II) and step length asymmetry (SLA) index >1.08. Two subjects: hemiplegic; three subjects: asymmetrical diplegia.

MATERIALS/METHODS: Subjects trained for 18 sessions (x2-3/week): 20 min. of dual belt treadmill walking (TR) at self-controlled speed while receiving visual and proprioceptive feedback regarding SLA. Visual feedback was provided by an immersive virtual environment (VE) with optic flow providing feedback on gait speed; and curving of the virtual locomotion path providing feedback on gait asymmetry. Proprioceptive feedback was provided by the independently speed-updating belts, such that step length asymmetry was directly related to belt speed differences. TR was followed by 15 min. of over-ground gait training to encourage transfer of learning. Subjects were evaluated pre and post, and at 1 months follow-up (FU) for (1) asymmetry and gait speed at their comfortable (CGS) and fast gait speeds (FGS) using a GAITRite mat; (2) O₂ cost of walking (CW) during a 6-minutes-walk (6MW); and (3) dynamic balance using the Four Step Square Test. Results are presented as pre-post/FU comparisons and compared to previous literature when appropriate.

RESULTS: All five subjects demonstrated two or more positive changes. Three subjects increased CSG by 0.2m/s or more; one by 0.07m/s, and the fifth had 'normal' CGS (1.35m/s). SLA improved in four of five subjects, with three subjects achieving gains ≥ 0.12 , and three out of five achieving SLA below the published threshold of 'normal' gait at the post-test. Two subjects improved 6MW by >120ft. Two subjects improved CW. Two subjects had no change in CW despite demonstrating improvement in CGS and SLA (post and FU); one of these also improved FGS, and SLA during FGS. Four out of the five subjects improved on the FSST.

CONCLUSIONS: Adults with CP can change gait parameters following gait training with ongoing combined visual and proprioceptive feedback, and therapist administration. Several subjects exhibited robust changes, while others did not. The high functional level of our subjects may have produced a ceiling effect on some variables. Further study of immediate changes and long-term retention of gait and functional balance is needed. Essential cognitive processing skills and appropriate patient selection for successful implementation should be considered.

CLINICAL RELEVANCE: Clinicians should consider training gait symmetry for appropriate ambulatory adults with CP, to address deficits that have an impact on safety, health and QOL.

PHYSICAL THERAPISTS ROLES IN THE MANAGEMENT OF CHILDHOOD OBESITY: MEASURING PHYSICAL ACTIVITY AND FITNESS

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PURPOSE/HYPOTHESIS: Management of childhood obesity in primary care often requires a multidisciplinary team approach. Roles for physical therapists include measuring physical activity (PA) and fitness levels. The purpose of this study was to measure PA and fitness in clinic and community settings for youth who are overweight or obese.

NUMBER OF SUBJECTS: Participants (n = 82) were children with a mean age of 10.29 years (SD = 1.87) and most were boys (55%). The mean body mass index (BMI) was at the 99.9th (SD = 1.97) percentile age-for-gender. Children wore ActiGraph GT1M accelerometers for 3 to 7 days (mean = 5.55 days (SD = 1.34)). Mean baseline heart rate (HR) was 96.43 bpm (SD = 14.56). Mean resting blood pressure (BP) was Systolic 113.88 mmHg (SD = 13.25)/ Diastolic 76.71 mmHg (SD = 11.98).

MATERIALS/METHODS: Children were recruited from primary care clinics. Parents and children completed demographic and PA questionnaires. Children were measured in the clinic for height and weight and participated in a Balke submaximal treadmill test while wearing a Polar

HR monitor. BP was measured pre and post treadmill test. Youth and parents were instructed in wear and care of the ActiGraph accelerometers. Youth agreed to wear the accelerometers for up to 7 days and they completed PA logs. Parents mailed the accelerometers back to the clinic when done.

RESULTS: Only 24 youth (29%) met the recommended level of 60 minutes of daily moderate to vigorous PA based on activity counts. However, 47.4% of children and 46.5% of parents indicated by self-report that children met recommended levels of PA. ActiGraph identified active vs. non-active youth more accurately than parent or child report as confirmed by youth fitness levels (BP and HR). Mean max HR achieved during treadmill testing was 150.87 bpm (SD = 19.43) suggesting that youth worked at 80% max HR during Phase II of the treadmill test.

Mean post-exercise BP was Systolic 115.39 mmHg (15.2)/ Diastolic 78.15 mmHg (12.35) which is similar to baseline BP. Both baseline and post-exercise systolic BP values are close to pre-hypertension values for these youth.

CONCLUSIONS: ActiGraph is a more accurate measure of PA compared to parent or child self-report. Youth in this study were deconditioned as indicated by HR and BP values during and post submaximal Balke treadmill testing.

CLINICAL RELEVANCE: ActiGraph is a feasible clinical measure and may be important to examine PA levels and intensity in the community. Also, treadmill testing is feasible in the clinic and may be important to determine fitness levels in youth who are overweight or obese. Youth PA levels may inform the design and dosing of PA in physical therapy interventions. ActiGraph activity counts may be an important outcome measure to examine effectiveness of physical therapy health promotion and fitness interventions.

SPATIAL COGNITION IN INFANTS WITH MYELOMENINGOCELE: TRANSITION FROM IMMOBILITY TO MOBILITY

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PURPOSE/HYPOTHESIS: Previous studies with typically developing (TD) infants have shown that the onset of mobility facilitates advancement in spatial cognitive skills. Although there have been several studies investigating various forms of mobility in TD infants, there have been limited studies observing the developmental changes in infants with motor disabilities. The purpose of this investigation was to document spatial cognition performance in TD infants and infants with myelomeningocele (MMC), to determine the role of mobility experience in spatial cognitive development. The hypothesis was that significant differences would be seen in three spatial cognitive paradigms: (1) visual control of

posture (2) shape perception and (3) joint visual attention in both TD and MMC infants after the onset of mobility.

NUMBER OF SUBJECTS: There were 30 TD infants, 8-9 months of age equally divided into crawling and non-crawling groups. There were 5 infants with MMC, ranging from 7.5 months to 16 months of age.

MATERIALS/METHODS: All infants were tested in three spatial cognitive paradigms: (1) moving room testing the visual control of posture (2) extraction of invariant form testing shape perception and (3) following the point and gaze testing joint visual attention (JVA). MMC infants were investigated longitudinally in all three paradigms observing spatial cognitive performance as they progressed from immobility to crawling. MMC infants were compared from their immobility period to mobility period. TD infants were tested once in each of the spatial cognitive paradigms and compared by mobility groups.

RESULTS: The results showed the crawling TD group displayed significantly higher performance on all three spatial cognitive tasks compared to the non-crawling TD group. A two by two ANOVA was performed in the extraction of invariant form showing significant interaction, $F(1,52) = 7.96, p = 0.006$. Similarly, a two by two ANOVA was performed in JVA, showing a main effect for looking direction $F(1,56) = 23.54, p = 0.0001$ and demonstrating a significant interaction, $F(1,56) = 3.76, p = 0.001$. The moving room paradigm showed the crawling group ($M = 0.59$) demonstrated higher cross correlation scores than non-crawling ($M = 0.45$) ($t(28) = 2.16, p = 0.04$). The MMC infants showed improvements on all three tasks after they transitioned to independent mobility, however, only the changes on the shape perception task was statistically significant. A two way repeated measure ANOVA revealed a significant interaction $F(1,3) = 41.26, p = 0.008$.

CONCLUSIONS: These results highlight the importance of mobility experience in spatial cognitive development. Furthermore, the results reveal a reduction in spatial cognition performance in the MMC infants.

CLINICAL RELEVANCE: Pediatric physical therapists promoting mobility skills in MMC should consider advancing mobility for environmental independence and for the added benefit of spatial cognitive development.

CEREBRAL PALSY: THE LOSS OF COMPLEXITY HYPOTHESIS

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PURPOSE/HYPOTHESIS: According to the loss-of-complexity hypothesis (e.g., Goldberger, 1997), in the case of pathology, the multi-scale, nonlinear complexity characteristic of healthy physiological systems

breaks down and the adaptability of the physiological process is reduced. The purpose of this study is to evaluate whether children with CP exhibit postural sway dynamics consistent with the loss of complexity hypothesis.

NUMBER OF SUBJECTS: Postural sway was quantified in children with CP ($n = 30$) compared to a control group ($n = 30$) of comparably aged, typically developing children.

MATERIALS/METHODS: Postural stability data were obtained using an AMTI AccuSway PLUS portable force platform system (Advanced Mechanical Technology, Inc., Watertown, MA). All participants completed six 20 second static stance trials. Three of the trials were performed with the feet shoulder-width apart. The remaining three trials were performed with the feet in a Tandem Romberg position. This stance narrowed the base of support in the medio-lateral plane and was expected to magnify baseline stability differences between the two groups. Recurrence quantification analysis (RQA) was employed to provide multiple indices of the time-varying properties of postural sway, including measures of the degree of randomness (determinism), mathematical stability (maxline), complexity of the deterministic structure (entropy), and degree of non-stationarity (trend) in each center of pressure time series (see Webber & Zbilut, 2005).

RESULTS: Significant Group x Foot Position interactions were detected in the % determinism measure, $F(1, 58) = 22.82, p < .05$, and $F(1, 58) = 21.30, p < .05$, for AP and ML sway, respectively. Relative to a shoulder width stance, in the tandem Romberg position, the COP time series of TD participants were more deterministic (predictable). In contrast, in children with CP, % determinism remained relatively unchanged across foot positions. Significant Group x Foot Position interactions for the RQA entropy measure were detected in the AP and ML COP time series respectively, $F(1, 58) = 4.57, p < .05$, and $F(1, 58) = 12.54, p < .05$. TD participants exhibited significantly higher RQA entropy (greater complexity of the deterministic structure of the COP) in the tandem Romberg position in relation to shoulder-width stance, whereas CP children showed no significant changes across foot position conditions.

CONCLUSIONS: In general, the results support a priori hypotheses regarding the changing nature of postural sway in the face of disease. Dynamic measures indicate that CP is associated with a loss of the complexity that characterizes postural sway in healthy individuals. The tandem romberg foot position did not exacerbate the postural sway profile in children with CP.

CLINICAL RELEVANCE: The results of this work motivate new research questions to be pursued in future investigations. Static posturography and spatiotemporal dynamics measures could be used as indicators of level of recovery or of rehabilitation progress.

SUPRA-POSTURAL TASK PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY

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PURPOSE/HYPOTHESIS: Goal-directed tasks that are super-ordinate to the simultaneous control of posture are called supra-postural tasks (Riccio & Stoffregen, 1988). Coordination of postural control with supra-postural activity may require that postural sway is modulated in order to avoid interfering with and in some cases to directly facilitate supra-postural activity (e.g., Riccio & Stoffregen, 1988). The purpose of this study was to investigate postural stability in children with Cerebral Palsy (CP) during performance of supra-postural tasks.

NUMBER OF SUBJECTS: Postural stability during supra-postural task performance was measured in 60 children [$n = 30$ children with CP, 30 typically developing (TD) children].

MATERIALS/METHODS: In this study, two supra-postural tasks were examined. In Task I, participants were asked to hold a stylus in the center of a copper tube aperture without touching the sides. In Task II, participants were required to keep a rolling marble in the center of a clear hollow tube. In order to examine postural stability during these functional activities, each supra-postural task was performed while the children were concurrently standing on a portable force platform system (Advanced Mechanical Technology, Inc., Watertown, MA). Dependent measures included the within-trial standard deviation of the center of pressure (COP) time series in the anterior-posterior and medial-lateral directions (AP and ML).

RESULTS: Two-way mixed factor ANOVAs exploring the effect of group and supra-postural task revealed a group x task interaction, $F(1, 58) = 85.92, p < .05$ and $F(1, 58) = 42.76, p < .05$, in the AP and ML COP time series.

Children with CP exhibited reduced sway variability during the pointing task relative to the no task condition. In the AP time series, a change in sway variability was also detected for TD patients, but in the opposite direction. In the ML time series, although a group difference existed in the no task condition, the difference was attenuated in the supra-postural task condition. An identical pattern of results was observed in Task II. A two-way mixed-factor (group x supra-postural tube task performance) ANOVA revealed a group x task interaction in the AP and ML postural variability measures (AP: $F(1, 58) = 86.92, p < .05$, ML: $F(1, 58) = 61.35, p < .05$). The AP and ML COP variability decreased during performance of the tube task in children with CP. Again, TD patients exhibited increased sway variability in the AP COP and no difference between groups in the ML time series during performance of the marble game.

CONCLUSIONS: These findings suggest that children with CP demonstrate flexibility in the postural control system when it is constrained by concurrent activity.

CLINICAL RELEVANCE: This study reflects coordination between the postural demands of a supra-postural task and corresponding demands of upright stance. The findings have achieved a status of clinical significance, to the extent that the COP times series of children with CP were moved within the range of the functional population (Jacobson et al., 1984).

EFFECTIVENESS OF SPINAL STABILIZATION EXERCISES FOR LOW BACK PAIN IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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PURPOSE/HYPOTHESIS: The majority of adolescents with idiopathic scoliosis (IS) develop low back pain (LBP). Spinal stabilization exercises are a common physical therapy (PT) intervention in adolescents with LBP and are effective in adults with LBP. No studies have evaluated the effectiveness of spinal stabilization exercises for managing LBP in AIS. The purpose of this study was to investigate whether or not 8 weeks of weekly supervised spinal stabilization exercises compared to one-time treatment would reduce pain intensity and disability and improve back muscle endurance, functional limitations, and participants' perceived changes in participants with LBP and AIS.

NUMBER OF SUBJECTS: Forty-one participants with AIS and LBP agreed to participate. Thirty participants (15 in the supervised group, 15 in the control group) completed the 8-week post-treatment assessment.

MATERIALS/METHODS: Participants were randomly assigned either to the supervised group or to the control group. The supervised group received weekly supervised

PT for 8 weeks. The control group received a one-time treatment and an 8-week home exercise program on DVD. Both groups received the same standardized spinal stabilization exercise program with specific criteria for progression. Exercise progression was determined by the treating PTs for the supervised group and by the participants/caregivers for the control group. The following outcome measures were collected before and after 8 weeks: Numeric Pain Rating Scale (NPRS) for pain intensity, prone-double-leg-raise (PDLR) for back muscle endurance, Patient-Specific Functional Scale (PSFS) for functional limitations, Revised Oswestry Back Pain Disability Questionnaire (OSW) for disability and the Global Rating of Change (GROC) for participants' perceived changes. Four 2×2 ANOVAs with repeated measures ($\alpha = 0.05$) were used to analyze the NPRS, PDLR, PSFS, and OSW. A Mann-Whitney U test ($\alpha = 0.05$) was used to analyze the GROC.

RESULTS: The ANOVA results revealed a significant interaction for the NPRS ($P = 0.01$) and PSFS scores ($P = 0.03$), but not for the PDLR and OSW scores. Further, post-hoc analysis revealed significant between-group and within-group differences in both the NPRS ($P < 0.01$) and PSFS ($P < 0.01$), showing that both groups improved, but the supervised group had significantly greater improvements in pain intensity and functional limitations than the unsupervised group. There were no between-group differences in the GROC after the 8-week PT intervention.

CONCLUSIONS: The results of this study indicate that supervised PT is superior to one-time treatment in improving pain intensity and functional limitations in AIS and LBP.

CLINICAL RELEVANCE: Spinal stabilization exercises may provide clinicians with an evidence-based treatment option for adolescents with IS with LBP. This study serves as a basis for optimal PT duration, frequency, and exercise type.