

Abstracts* of Poster Presentations at the 2010 Section on Pediatrics Annual Conference

PHYSICAL THERAPY EVALUATION AND TREATMENT OF A TODDLER WITH SENSORY-MOTOR DYSFUNCTION

D.K. Anderson

BACKGROUND & PURPOSE: Pediatric physical and occupational therapists are currently being challenged by the growing number of infants and toddlers without known neurological conditions who present with sensory-motor dysfunction. The purpose of this case report is to describe and discuss the physical therapy management of a toddler with sensory-motor dysfunction.

CASE DESCRIPTION: K.D., a 12 month old child, presented with hypotonia, muscle weakness, and decreased postural control. K.D. exhibited a significant delay in gross motor development (40%) as well as difficulty initiating movement or tolerating imposed movement. *The Peabody Developmental Motor Scales-2nd edition (PDMS-2)* as well as the *Infant Toddler Sensory Profile* were used for examination. Pediatric physical therapy interventions consisted of techniques to increase proprioception, strengthening activities, endurance activities, and exposure to a variety of movements, environments, and novel motor experiences.

OUTCOMES: K.D.'s scores on the *PDMS-2* improved significantly over time. K.D. achieved age appropriate gross motor skills as well the ability to participate in peer related play and learning activities.

DISCUSSION: Sensory-motor dysfunction can inhibit a child's development as well as diminish participation in family and community activities. Early identification of sensory-motor dysfunction and early intervention assisted this child and her family in achieving successful motor and participation outcomes. Further research is needed to determine best practice in identification and treatment of children with sensory-motor dysfunction.

ADAPTIVE SOCCER PROGRAM

L. Babcock

PURPOSE: Determine if participation in a community based adaptive soccer program could improve the cardiovascular fitness and quality of life for children with special needs.

DESCRIPTION: 18 children with both physical and cognitive challenges participated in an adaptive soccer program held at a community soccer facility. Cardiovascular fitness measure included pre and post test of heart rate. The PedsQL was utilized to measure the impact on the quality of life.

SUMMARY OF USE: While the data for cardiovascular fitness should no significant change, quality of life measurements showed improvement in a number of dimensions. At the request of the parents, additional sessions were conducted to accommodate more participants.

THE RELATIONSHIP BETWEEN IN-SCHOOL PHYSICAL ACTIVITY AND STANDARDIZED TEST SCORES IN ELEMENTARY SCHOOL STUDENTS

K.A. Brawley, M.M. Fisher, A.L. Penatzer, M. Persun, S.R. Simonds, L.M. Smith, E.L. Telford

PURPOSE/HYPOTHESIS: This study is being conducted through a survey to investigate the relationship between elementary school physical activity time and the school's Pennsylvania System of School Assessment (PSSA) scores. Possible differences between scores comparing participation of students in structured and unstructured physical activity are assessed. The purpose of this study is to enhance the importance of physical activity in children. It is hypothesized that there will be a positive correlation between increased physical activity and higher scores on the state assessment test. The results of this research hope to add to the field of knowledge in physical therapy, as well as improve awareness in the education field regarding the importance of physical activity in the developing child's lifestyle.

MATERIALS/METHODS: A review of published literature regarding physical activity and its correlation to learning, as well as literature explaining the neuroscience

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

involved with physical activity and neurological changes, was conducted. Third and fourth grade teachers in rural and urban elementary schools across the state of Pennsylvania were asked questions about their students' physical activity during a typical education week. The responses to a set of detailed questions are being compared to the scores on the school's state assessment test. This is a retrospective, quantitative study using survey methodology of Pennsylvania elementary schools. This study was approved by Saint Francis University's Institutional Review Board (IRB).

RESULTS & CONCLUSIONS: Preliminary analysis of fifty responses from Pennsylvania elementary school surveys report: 1) average recess of 4.90 (+ 0.36) days per week; 2) average recess of 1.18 (+ 0.39) times per day; 3) average recess time of 16–30 (2.04 + 0.49) minutes per day; 4) average physical education (PE) class of 1.38 (+ 0.49) days per week; 5) average PE of 21–40 (2.20 + 0.40) minutes per class; 6) average PSSA math score of 81.56% (+11.38), with 21 schools below this average and 29 schools above this average; 7) average PSSA reading score of 74.62% (+ 10.03), with 23 schools below this average and 27 schools above this average. Further analysis of the results is ongoing to determine if there is a relationship between the amount of physical activity and PSSA scores of elementary schools. Expect completed results by January 2010. The data are currently being assessed by the researchers. Expect the conclusions to be completed by January 2010.

CLINICAL RELEVANCE: The results of this research hope to add to the field of knowledge in physical therapy and in the promotion of health and wellness in the pediatric population. Physical activity encourages neuroplasticity, therefore improving a child's lifestyle and learning abilities.

THE DEVELOPMENT OF SINGLE LIMB STANCE IN CHILDREN AGES TWO TO TWELVE YEARS

N. Darr

PURPOSE/HYPOTHESIS: Single limb stance (SLS) is a functional balance skill employed throughout the lifespan. SLS items are part of many developmental tests including the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition and the Peabody Developmental Motor Scales, Second Edition. CDC guidelines state that 4 year -old children should be able to perform single limb stance for 5 seconds and 5 year-old children for 10 seconds; however, a review of the literature revealed no recent developmental reference values for single limb stance. The purposes of this study were to determine the age at which children can consistently stand on one foot for 10 seconds, and to examine the development of single limb stance performance in two to twelve year-old children.

NUMBER OF SUBJECTS: Data were collected on 642 children developing typically, ages 2 to 12 years, as part

of a larger study examining typical performance on the Pediatric Balance Scale (PBS).

MATERIALS/METHODS: Data for the present study were gathered from the SLS item on the PBS. Children stood on one foot in a standardized position with the weight bearing limb on a line, the non-weight bearing knee bent and the arms across the chest. Specific criteria were followed for starting and stopping timing and for floor contact with the weight bearing foot. The mean of three trials was calculated for each child. Children were divided into age groups in 6 month increments up through the age of 7 years, and into one year increments for the 8 through 12 year old groups. Data were analyzed descriptively, and a Kruskal-Wallis ANOVA was performed to identify significant differences between age groups in performance of SLS.

RESULTS & CONCLUSIONS: Two year-old children were either unable to assume SLS (33.3%) or were unable to hold SLS more than three seconds (66.7%). Most three year- old children (84.5%) were able to assume SLS, but only 15.5 % were able to hold SLS for 10 seconds. SLS continued to gradually improve between 42 and 65 months. In the 60 to 65 month group, all children could assume SLS and 72.7% could consistently maintain SLS for 10 seconds; however, performance declined in the 66 to 71 month group, and only 58.6% of the children could consistently maintain SLS for 10 seconds. The ability to maintain SLS for 10 seconds gradually increased between 72 months (65.7%) and 90 months (84%), then declined again slightly in the 8 year old age group (76.9%). It was not until the age of 9 years that all children in the test sample could consistently perform SLS for 10 seconds across three trials. Performance differences between two year-olds and three year-olds and children of four years or more were significant ($H=185.7$, $df=17$, $p<0.0001$).

CLINICAL RELEVANCE: Many children ages five years and older may not be able to perform SLS consistently for 10 seconds. A decrease in SLS performance, between 60 and 90 months of age is consistent with a similar decline in other challenging balance tasks seen in this age group. The development of SLS may not follow a linear progression.

DIFFERENT BUT STILL FRIENDS: ACQUAINTING PRESCHOOLERS TO PEDIATRIC ADAPTIVE EQUIPMENT

K.N. Drndarski

PURPOSE: Pediatric physical therapists are driven to have their clients become active members of their community, using any adaptive equipment they may need. As professionals working with children, PTs are in a position to educate others towards accepting disability and supporting participation that is fostered and promoted in the clinic setting. Previous literature has focused on illustrating similarities between children with and without disabilities; however this work notes differences while accentuating a common bond in school, which can be

friendship. Part of the responsibility of advocating participation for children with special needs is educating those without disabilities in the community as to what these pieces of adaptive equipment look like and why they are used. Children who are offered this information prior to creating biases from unawareness can develop healthy perceptions of those who appear different due to their abilities. This case report describes a pediatric adaptive equipment presentation created for 4 year old preschool students with suggestions for reproducing the learning concepts developed.

DESCRIPTION: Families were given a letter describing the topic and teachers completed a needs analysis regarding how their students learn best. Five straightforward learning concepts were presented. The concept of differences highlighted diversity in the children's appearance, while still being friends. The concept of tool use focused on using the appropriate device required by a simple task. Posters were displayed with high contrast depicting big tools and machines that are used for mobility in the community and travel. Then children were given the opportunity to physically explore and handle a pediatric sized wheelchair, walker, and ankle foot orthoses. The children took turns positioning themselves in the wheelchair and operating the seat belt. The learning experience was reinforced by the reading of a story book depicting a child who uses a wheelchair making friends with his new classmates. In finishing, the children asked their questions. Each child took home a feedback form to assist the family in discussions regarding this topic. All adult and parent attendee's written responses were positive and appreciative towards this learning experience. After the presentation, most parents commented that their child had spoken to them regarding the topic, with a sense of gained awareness.

SUMMARY OF USE: Pediatric PTs can use their expertise in working with children with special needs to guide preschool students in gaining disability awareness by exposing them to adaptive equipment typically used in the community. This can be accomplished by using basic concepts and fun demonstrations without reviewing pathology. The focus of the concepts is to see a person using a supportive tool for the right need, instead of focusing on a diagnosis. The feedback forms for the families included multiple resources that advocate and educate about disability awareness to further their own knowledge and direct their child's learning.

USING THE "INTERACTIVE METRONOME" FOR IMPROVED MOTOR, SPEECH AND READING SKILLS OF AN EIGHT YEAR OLD BOY WITH A CARDIAC DISORDER

D. Evans-Rogers

BACKGROUND AND PURPOSE: The Interactive Metronome™ is a tool currently used by pediatric physical therapists to assist children with their ability to focus

attention and for motor planning skills requiring balance and timing. The purpose of this case report was to explore using a computer based Interactive Metronome™ program and to ascertain any changes in an 8 year old boy with a cardiac disorder with gross motor, speech, and reading delays. Twelve one-hour Interactive Metronome™ sessions were provided over a five-week period. A pre- and post-interactive Metronome™ assessment was performed with motor, reading skills, and subjective changes documented before and after the intervention. **OUTCOMES:** A paired t-test showed statistically significant ($p < .05$) improvement pre- to post-intervention using the Bruininks-Oseretsky Test of Motor Proficiency. Standard scores improved in all reading areas using subtests of the Woodcock-Johnson III Tests of Achievement. Subjectively, qualitative improvements were also noted by parents, teachers, and therapists. Results indicate improvements in motor and reading skills of one child with a cardiac disorder indicating positive measurable outcomes of physical therapy with the Interactive Metronome.™

DISCUSSION: The timing and rhythmicity of an Interactive Metronome™ program may result in improvements with children having cardiac disorders in motor and reading skills. Further research is needed to determine the efficacy of using the Interactive Metronome™ for children with a variety of disabilities.

THE EFFECT OF HIPPOThERAPY ON FUNCTIONAL GROSS MOTOR DEVELOPMENT AND SELF CONFIDENCE ON A 6-YEAR-OLD CHILD WITH CEREBRAL PALSY

A. Frank

BACKGROUND & PURPOSE: The purpose of this case study was to determine whether hippotherapy had an effect on the general functional development and perceived self competence of a young girl with cerebral palsy.

OUTCOMES: The child received hippotherapy for 45 minute sessions, 2 times a week, for 8 weeks, totaling 16 sessions. The following outcome measures were used: Gross Motor Function Measure-66, Pediatric Outcomes Data Collection Instrument, Pictorial Scale of Perceived Competence and Social Acceptance for Young Children, and progress towards the achievement of 5 functional short term goals. Subject was tested at Initial Evaluation, after 8 weeks of twice weekly hippotherapy and for Retention- 8 weeks after hippotherapy ended.

DISCUSSION: This case study demonstrated that hippotherapy intervention 2 times per week was an effective intervention tool in improving gross motor function and self confidence at a functional limitation and disability level. Strength, balance and coordination that were developed on an impairment level during sessions carried over to improvement in functional tasks at the re-evaluations. GMFM-66 scores in the area of Walking, Running, and

Jumping continued to increase 8 weeks after hippo-therapy ended, with continued functional gains in balance, coordination, and endurance noted, and significant improvements in sports and physical function, with increased peer acceptance after hippotherapy ended. The overall goal for children diagnosed with CP is for them to grow and develop to their maximum capacities so that they may succeed as contributing members of the society in which they live. Reaching maximum capacity includes gaining as much functional independence as well as autonomy with social, educational, and recreational skills. Treatment needs to focus on all levels of the disability including impairments, functional limitation, and quality of life.

ANTICIPATORY POSTURAL ADJUSTMENTS IN CHILDREN WITH CEREBRAL PALSY: PRELIMINARY DATA

G.L. Girolami

PURPOSE/HYPOTHESIS: The purpose of this study is to investigate anticipatory postural adjustments (APAs) in children with diplegic and hemiplegic cerebral palsy, during bilateral, unilateral and reciprocal shoulder flexion and extension tasks performed in standing. Anticipatory activity in trunk and lower extremity muscle groups on both the right and left side, and anterior/posterior changes in center of pressure (COP) were studied. In addition, each subject was tested using the Gross motor Function Measure (GMFM). Hypotheses: 1) Children with cerebral palsy can produce directionally specific APA patterns (EMG activation and COP displacement) depending on the task. 2) There will be a correlation between groupings of APA patterns and performance on individual items on the Gross Motor Function Measure (GMFM).

NUMBER OF SUBJECTS: Ten children with a diagnosis of spastic diplegia and 10 children diagnosed with spastic hemiplegia, between the ages of 7–16 years, with Gross Motor Function Classification Scale (GMFCS) levels 1 or 2 will be recruited for this study. (At this time, 17 subjects have been enrolled.) Children who have had orthopedic surgery or Botox injections within six months prior to recruitment will be excluded from the study.

MATERIALS/METHODS: Subjects were asked to stand on a force platform and perform shoulder flexion and extension tasks under bilateral (weighted and non-weighted), unilateral and reciprocal conditions. EMG data from 12 trunk and lower extremity muscle groups were collected. A unidirectional accelerometer was taped to the dorsal surface of the dominant hand to mark the onset of movement. To date, EMG data has been filtered and aligned for the 17 subjects who have completed the study. We anticipate recruiting the final three subjects in the next two months with data processing and analysis scheduled to be completed by October. Statistical analysis will be performed using repeated measures ANOVA.

RESULTS: EMG traces from the preliminary 17 subjects with diplegic and hemiplegic cerebral palsy have been plotted. When the data collection is completed, the EMG data will be normalized and integral EMGs will be calculated, as well as anticipatory changes in COP.

CONCLUSIONS: Preliminary analysis of the plotted EMG activity in children with diplegia and hemiplegia indicate that children with CP are able to produce directionally specific anticipatory postural adjustments depending on the direction of the perturbation. Thus, preliminary data seems to indicate that the central nervous system of children with CP (GMFCS 1 and 2) can differentiate between symmetrical and rotational nervous system of children with CP (GMFCS 1 and 2) can differentiate between symmetrical and rotational perturbations and select directionally specific solutions to maintain balance. **CLINICAL RELEVANCE:** This will be the first study which uses EMG to investigate and describe APAs in children with CP as they perform functional arm movements in standing. Results from this study may provide insights into how children with CP organize feedforward muscle activity. Further, scores on the GMFM may offer a means to correlation competence in the performance of functional skills with ability to generate specific patterns of muscle activity, perhaps leading to the development of evidenced based treatment strategies.

ANTICIPATORY POSTURAL ADJUSTMENTS IN CHILDREN WITH TYPICAL MOTOR DEVELOPMENT

G.L. Girolami

PURPOSE/HYPOTHESIS: To investigate anticipatory EMG activity in the trunk and lower extremities and anterior and posterior changes in center of pressure (COP) in children with typical motor development during bilateral, unilateral and reciprocal shoulder flexion and extension tasks performed in standing. Study Questions 1) Can children with typical motor development produce directionally and task specific APA patterns (EMG activation and COP displacement)? 2) Do children with typical motor development scale APAs with the magnitude of the perturbation? 3) How do children with typical motor development sequence anticipatory muscle activity during shoulder flexion and extension tasks?

NUMBER OF SUBJECTS: A convenience sample of 10 children age 7–16 years, with no known history of neurological, musculoskeletal or visual impairments was recruited.

MATERIALS/METHODS: EMG electrodes were applied to the right and left trunk and lower extremity muscle groups, and subjects stood on a force platform to perform bilateral, unilateral and reciprocal shoulder flexion and extension tasks. A unidirectional accelerometer was taped to the dorsal surface of the dominant hand to mark onset of movement. EMG data were filtered and aligned and integral EMGs were calculated for all the tasks and averaged across subjects. Anticipatory changes in COP

were also calculated. Patterns of muscle sequencing prior to the shoulder flexion and extension tasks were determined. Statistical analysis was performed using repeated measures ANOVA.

RESULTS & CONCLUSIONS: During bilateral shoulder flexion, EMG data revealed anticipatory activity in the dorsal muscle groups of the trunk and legs (right and left erector spinae ($p < .001$); right biceps femoris ($p < .01$), and suppression in the ventral muscle groups; this activity was accompanied by the posterior COP displacement. During bilateral shoulder extension, anticipatory EMG activity was present in the ventral muscle groups (right and left rectus abdominus ($p < .001$); right rectus femoris ($p < .01$) with suppression of the dorsal groups; the COP was in the anterior direction. For both the right and left reciprocal arm swing tasks, there was anticipatory activation of dorsal muscle groups on the side of the forward moving arms and anticipatory activation of the ventral muscles on the side of the arm moving into shoulder extension (right rectus abdominus ($p < .01$); right rectus femoris ($p < .01$) and left rectus abdominus ($p < .05$); left rectus femoris ($p < .05$). COP displacement during this task was minimal. Children with typical motor development were able to produce directionally and task specific EMG activity and changes in center of pressure prior to the initiation of upper extremity tasks in standing.

CLINICAL RELEVANCE: These data are part of a larger study investigating (APAs) in typically developing children and children with cerebral palsy. Information from this study may serve to expand our knowledge of anticipatory postural control in typically developing children, allow for comparisons between the two groups of children and potentially contribute to the development of treatment interventions to improve postural control APAs in children with CP.

USE OF ADAPTED SWIMMING TO IMPROVE FITNESS FOR CHILDREN WITH CEREBRAL PALSY

D.A. Guebard

PURPOSE: Children with cerebral palsy need fitness activities just like other children their age. They should be able to participate in appropriate competitive activities where they are challenged to improve independent skills, general fitness, experience a team and sportsmanship.

Some children with CP need ongoing PT activities, but not direct Physical Therapy. With these needs in mind, the Turnstone Lap Clubs evolved as a unique idea for a different Physical Therapy model with specific goals for adapted swimming for team members and their families

DESCRIPTION: Turnstone Lap Club criteria outline specific criteria for Lap Club involvement, with initial contact by an Aquatic Therapy evaluation by a P.T. Special adaptations are made for each individual child. A variety of floatation equipment is utilized so each child accomplishes maximum independence for swimming. Children are placed on the appropriate team depending on their

swimming abilities. Goals are established for each individual and for teams for each session.

SUMMARY OF USE: Adapted swim teams provide participation and competition for kids with CP who would otherwise never be able to participate in fitness activities or on a team. Children with CP improve strength and endurance with regular fitness activities. Parents report improvements in function, independence and endurance for daily activities with participation in the swim team. Improvements in personal best times for one lap from one session to the next have been noted. Remarkable improvements in confidence and independence in the water, as well as improved overall strength and endurance have also been noted. Already established Physical Therapy goals are addressed and accomplished in an alternative PT model.

THE CEREBRAL PALSY RESEARCH REGISTRY

D. Hurley, T. Sukal, D. Gaebler-Spira, M. Msall, K. Krosschell, J.D. Dewald

PURPOSE: The purposes of the Cerebral Palsy Research Registry are to:

1. Maintain a secure database to connect interested families with researchers studying cerebral palsy. Participation in the Registry does not directly enroll participants into research studies.
2. Promote collaboration between institutions regarding cerebral palsy research and study recruitment via the Registry website.
3. Provide families with community resources, current information on cerebral palsy and advocacy via the Registry newsletter and website.

DESCRIPTION: Active and passive recruitment has been used for enrollment into the Cerebral Palsy Research Registry. Active recruitment includes attending spasticity management/ cerebral palsy clinics at two metropolitan hospitals and speaking at parent support groups. Passive recruitment includes brochures in clinics, speaking engagements for occupational and physical therapists, letters to parents via the public school systems and online registration on the Registry's website, www.cpregistry.org. With active recruitment, the Registry is explained to the participant and guardian, the consent is signed and the questionnaire filled out by the participant and/or guardian. The recruiter, physician, nurse and/or physical therapist establish clinical parameters such as GMFCS level, MACS and FMS scores. The participant is assigned a Registry number and all of the participant's information is entered into an online database. If the participant matches the inclusion criteria of an IRB research study approved by the Cerebral Palsy Research Registry study committee, the participant and his/her family is notified via U.S. mail. It is up to the participant and his/her family to contact the researcher directly regarding the particular

study. Yearly contact is made with participants to update information in the database.

SUMMARY OF USE: This project demonstrates that it is feasible to successfully recruit participants for a cerebral palsy research registry in a large metropolitan area. The initial 150 participants have a gender distribution similar to that reported in published accounts and represent a sample that is racially diverse. Participants were identified across all distributions of limb involvement and severity of motor and manual impairment. This data has been used for recruitment purposes for cerebral palsy research studies and will provide important descriptive information about a subset of the population within the clinical catchment area.

FEASIBILITY AND MOTOR OUTCOMES OF INTENSIVE PHYSICAL AND OCCUPATIONAL THERAPY FOR A CHILD WITH MOTOR COORDINATION DIFFICULTIES

S. Joshi

BACKGROUND & PURPOSE: The aim of this case study was to examine motor outcomes following intensive collaborative Physical (PT) and Occupational Therapy (OT) in a 5 year old girl with motor apraxia who had coordination difficulties that impacted ADL, sports and recreation and fit the criteria for Developmental Coordination Disorder (DCD). Intensive therapy was implemented to address poor carryover of learning and minimal change in function with once weekly therapy. Intensive therapy is reported to improve motor function in children with Cerebral Palsy but has not been investigated in children with DCD.

PROGRAM: Intervention was designed by PT and OT to address overlapping goals and improve functional skills through guided practice and repetition. **Methods:** The program was divided into 3 six week episodes of intensive therapy (Episode 1: PT 2X/week, OT 3x/week; Episode 2: OT 1X/week, PT 3X/week, Episode 3: OT 3x/week, PT 1x/week) with 12–20 weeks of no therapy or weekly therapy between 2 episodes. The total duration of the study was 54 weeks. Goal Attainment Scaling (GAS) was used to track qualitative changes in functional activities relevant to ADL, playground activities and recreation. Motor skills were assessed using the Bruininks Oseretsky Test of Motor Proficiency-2 (BOT-2).

OUTCOMES: A minimum of Expected Level of Performance or higher was achieved on all goals of the GAS following all 3 intensive episodes. After episode 1, greater than 40% increase was noted on BOT-2 point scores in Balance and Running Speed & Agility. Rate of change of point scores was larger during at least one intervention phase for Balance, Running Sp & Agility and Strength compared to breaks. From parent report, the child utilized skills learned outside the clinic (hopping, jumping rope, ball skills, dressing) and goal achievement from episodes 1 and 2 was maintained at the completion of intensive phase 3.

DISCUSSION: Intensive PT and OT may be feasible for children with motor coordination difficulties and their families. The two disciplines by addressing different aspects of skill acquisition may provide adequate practice in various contexts needed for carryover of skills to everyday life. Tracking achievement of individual therapeutic goals using the GAS may be effective in examining the impact of intervention on function. Further studies should determine the effectiveness of this model across ages and levels of severity of coordination deficits.

NATIONAL SURVEY OF PEDIATRIC EXPERTS INDICATES INCREASE IN INFANT DELAYS; MORE TUMMY TIME IS KEY

F. Kurkowski

PURPOSE: A national survey of 400+ pediatric physical and occupational therapists, averaging over 20 years' experience, confirms what early childhood medical professionals have been observing: two-thirds of therapists reported a rise in early motor delays in infants in the past six years, and those who saw an increase said that lack of tummy time while awake is the number-one contributor to the escalation in cases. An early motor delay occurs when a child isn't able to meet critical physical milestones in the first months and years of life, which can later affect a child's ability to learn basic skills such as chewing, grasping, crawling, standing and walking. Tummy time is supervised time while awake that babies spend on their stomachs. This poster is intended to bring attention to the results of this survey, reinforce the need for tummy time, and draw other medical professionals into this important conversation.

DESCRIPTION: This survey quantifies experienced observations by qualified professionals, which may serve as a hypothesis for a future scientifically controlled study on the rate of increase and causes of early motor delays. Two-thirds of therapists (66 percent) reported that they had observed an increase in early motor delays in babies under six months. Of therapists noting an increase in early motor delays, the vast majority named lack of tummy time as the number-one reason for the increase (84 percent), followed by the rise in premature births (59 percent) and back sleeping (54 percent). Nearly two-thirds (61 percent) of all respondents thought that Early Motor Delays could be caused or exacerbated by back sleeping, and 77 percent had observed Early Motor Delay cases that could be attributed to babies spending extensive time on their backs while awake (in car seats, bouncers, etc.). Therapists observed that most parents have little or no understanding of tummy time (70 percent).

SUMMARY OF USE: The vast majority of babies now sleep on their back to prevent Sudden Infant Death Syndrome (SIDS). Back-sleeping, coupled with more awake time in "containers" like car seats, bouncers and strollers, add up to so much back time that babies aren't able to develop their neck and back muscles, contributing to the

increase in early motor delays. A few simple tummy time tips include the following: Lay baby tummy down across your lap to sooth instead of holding upright on yours shoulder. Carry baby around the house tummy-side down instead of upright. Start infants with just a few minutes of tummy time per day, eventually building up to an hour a day, in spurts throughout the day, by three months of age. Standards for tummy time are also included.

USE OF A PARTIAL BODY WEIGHT SUSPENSION TRACK SYSTEM TO FACILITATE CREEPING AND GAIT IN A 3 YEAR OLD BOY WITH SPASTIC QUADRIPLÉGIA

R. Leonard, M. Rosenberg, J. Ries

BACKGROUND AND PURPOSE: Prone progression provides a means of locomotion & exploration. Creeping requires freedom from strong midline symmetry, refinement of axial rotation, reciprocal use of the limbs & counter rotational strength. Use of a partial body weight suspension track system (PBWSTS) affords a unique opportunity to train a child safely and effectively in quadruped and upright positions while the therapist facilitates the movement. A literature review reveals evidence for PBWSS to enhance walking, but no descriptions of PBWSS to train in quadruped. The purpose of this case study is to describe the use of PWBSTS to train creeping and upright skills in a young child.

CASE DESCRIPTION: A 3 year old boy with spastic quadriparesis presented with inability to move in quadruped & move actively while in a gait trainer. Attempts at quadruped mobility were characterized by limited weight bearing through all extremities due to posturing & weakness. In upright, the child was unable to propel forward in a gait trainer due to lack of hip extension power and his posturing. A PBWSTS with an overhead track, trapeze & vest was used 45 minutes, 2× for 4 months. First, the child was suspended in the quadruped allowing him to explore his environment in a 12 × 15 foot area. Second, the child was positioned in upright standing enabling him to freely step with assist and progress to walking short distances. Next, he practiced walking while in the PWBSTS with a forearm prompt walker. All tasks were facilitated by the therapist.

OUTCOMES: In the system, the child's quadruped skills improved such that he was able to: hold head upright for up to 2 minutes, use both arms to move forward, assume more weight bearing through knees and lower legs, and flex & extend at hips in a creeping pattern. Out of the system after 4 months, he was able to creep 6 feet with appropriate weight shifting & use of hip flexion/extension with therapist facilitation. In the system, the child's upright skill improved such that he was able to: to hold head upright for 10 minutes, extend thoracic spine, and move self forward with reciprocal stepping. After 2 months in the PBWSTS, the child, with assist to position

his legs out of internal rotation, was able to move gait trainer alone out of the system for 5–8 feet and progressed to use a forearm prompt anterior walker for 5 feet with therapist support.

DISCUSSION: Use of PBWSTS afforded this child the ability to move and explore his environment spontaneously with therapist facilitation for postural alignment & movement organization. The freedom of movement in this minimal friction system was a unique experience to a child who has known little independent mobility. The development of quadruped skill was associated with the gains in upright mobility both in a gait trainer and a walker. The use of the PBWSTS in quadruped, in addition to upright training, is a unique therapeutic intervention that warrants further research.

ANTICIPATORY POSTURAL ADJUSTMENTS IN CHILDREN WITH TOURETTE SYNDROME AND TYPICAL DEVELOPMENT

W. Liu, L. Hsu, H. Wang, H. Lien, A. Wong, C. Chen

PURPOSE/HYPOTHESIS: Tourette syndrome (TS) is a neurological disorder characterized by tics, and it usually has an onset in childhood. Aside from tics, previous studies have indicated that compared to healthy controls, children with TS demonstrated difficulties in procedural learning and also performed poorer in static standing balance than the healthy controls. Anticipatory postural adjustments (APAs) are learned postural activities considered as a crucial component of balance control. Essentially, APAs minimize the postural perturbation and maximize the stability of an on-going voluntary movement based upon the past experiences. However, no information is available regarding APAs in children with TS. Therefore, the purposes of this study were to describe the APAs in children with TS and to compare to those with typical development.

NUMBER OF SUBJECTS: Six children with TS and 6 age and gender matched children with typical development participated in this study.

MATERIALS/METHODS: All children reached repetitively to a moving target for 75 times while standing. The APAs were captured by kinematic profile of joints, muscle activation patterns, and center of pressure (COP) measurements (VICON Max, Oxford Metrics Limited, Botley, Oxford.) In essence, eight cameras were used to capture reaching movement with preamplified surface electrodes (Motion Lab Systems, Inc., Baton Rouge, LA) attached to bilateral postural muscles of lower extremities to record muscle activities. The excursion of COP was calculated from data registered by an AMTI force plate (Advanced Mechanical Technology Inc., Watertown, MA). Independent t-tests were used to compare the differences of measures between the two groups.

RESULTS & CONCLUSIONS: Typical postural adjustments accompanying reaching movements in the standing position, such as posterior COP shifting and anterior

tibialis activation before reaching, were observed in both groups. However, certain differences in APAs were evident in children with TS. Basically, the incidence of posterior COP shifting observed in all trials was lower ($p = 0.03$), the onset of posterior COP shifting and the activation of anterior tibialis was significantly late ($p < 0.001$) in the TS group. In addition, time difference between the onset of posterior COP shifting, as well as the onset latency of tibialis anterior muscles, and the initiation of reaching movements were longer ($p = 0.02, <0.05$ respectively) in children with TS than the healthy control children. These results suggest that children with TS had developed basic APA patterns, but still had difficulty in producing an optimal link between the voluntary movement and the accompanying postural adjustments in their temporal order.

CLINICAL RELEVANCE: The results of this study suggest that children with TS demonstrated anomalies in maintaining a link in temporal fashion between the initiation of focal movement and the activation of APAs. The results provide an additional evidence to support the need for evaluation and intervention of the postural control in children with TS in clinical settings.

GAIT PERFORMANCE IN CHILDREN WITH TOURETTE SYNDROME: A PRELIMINARY STUDY

W. Liu, P. Lin, H. Lien, H. Wang, A. Wong, F. Tang

PURPOSE/HYPOTHESIS: Tourette syndrome (TS) is a childhood-onset movement disorder characterized by vocal and motor tics. The pathophysiology of TS is not fully understood, but it is postulated that deficits in the basal ganglia and the related thalamocortical circuitry may be involved. To date, no reports have been published on the gait characteristics in children with TS. These characteristics warrant an examination because severe gait disturbances have been noted in other conditions with deficits in basal ganglia and related thalamocortical circuitry, such as Parkinson's disease. In this study, we compared the gait characteristics in children with TS to the healthy controls.

Number of Subjects: Sixteen children aged 7–12 years voluntarily participated in this study. There were 8 boys with TS and 8 healthy control children (5 boys and 3 girls).

MATERIALS/METHODS: All the children were instructed to walk at 2 self-selected speeds: "preferred" and "fastest." Each child completed 3 successful trials of each walking condition. All gait parameters were collected using an electronic walkway (GAITRite system, CIR Systems Inc., Havertown), including walking velocity, cadence, temporal-spatial measures of gait and related assessment of symmetry or variation of gait performance. A two-way ANOVA with one repeated factor (group vs. speed) were performed for statistical analysis of differences in gait between two groups and across two walking speeds.

RESULTS & CONCLUSIONS: In summary, children with TS demonstrated similar gait characteristics as the healthy controls under different walking speeds in most measures. Despite the small sample, salient changes in gait performance were identified from children with TS. Essentially, children with TS walked less symmetrically in their preferred speed as shown by larger asymmetrical ratio ($p = 0.002$) of step length and greater left-right discrepancy of step length in both walking speeds ($p = 0.013$).

CLINICAL RELEVANCE: Similar to healthy children, those affected by TS were capable of increasing their walking speeds by increasing their stride length and cadence. However, the results of our study suggest that children with TS may exhibit gait anomalies, such as irregular step length. This research presents preliminary evidence in the light of which further studies can be performed for the assessment of gait disturbances in children with TS under clinical settings.

THE EFFECT OF SUPRAMALLEOLAR ORTHOSES ON UPPER EXTREMITY SUPPORT DURING PLAY

J. Looper

PURPOSE/HYPOTHESIS: Play is an essential part of childhood. Play is the activity by which children explore their environment and learn how to deal effectively with their surroundings. It may be difficult to perform exploratory play in an upright posture when balance control is poor, as is the case in infants with Down syndrome (DS) (Kubo & Ulrich, 2006). However, supramalleolar orthoses (SMOs) can improve balance in children with DS (Martin, 2004). Orthoses may improve the ability of children with DS to engage in upright exploratory play by providing foot and ankle stability and therefore allow the children to use their hands to interact with objects during upright play, rather than for stability purposes.

NUMBER OF SUBJECTS: 17 children with DS enrolled in this study and randomly assigned to a control ($n=7$) or experimental ($n=10$) group.

MATERIALS/METHODS: The participants were followed in their homes from the time they could pull to stand until they could take 3 independent steps. Infants in the control group received treadmill training (TT). Infants in the experimental group wore SMOs for 8 hours/day in addition to TT. Every other month the researchers videotaped each child playing at a child's activity table for 20 minutes. The tapes were coded in the lab. When children were in an upright position, coders determined whether their trunk was leaning on the support surface or not, and whether they were using 0, 1, or 2 hands for weight bearing. **Results & Conclusions:** The average percentage of time spent throughout the study with 2 hands on the table while upright but not leaning was 43.70% (± 29.01) for the experimental group and 54.36% (± 28.14) for the control group over the course of the intervention. The control group spent significantly more time with 2 hands

on the support surface than the experimental group throughout the study ($p = 0.01$). The average percentage of time spent throughout the study with 1 hand on the table while not leaning 38.28% (± 26.47) for the experimental group and 40.97% (± 26.33) for the control group over the course of the intervention. There was a significant increase over time for both groups ($p = 0.03$). The average percentage of time spent throughout the study with 0 hands on the table while not leaning was 2.43% (± 8.57) for the experimental group and 1.82% (± 5.18) for the control group over the course of the intervention (figure 3.9). There was a significant quadratic effect of time ($p = 0.04$) which indicates that both groups showed a rapid change from holding on with one or two hands to standing without holding on. Orthoses seem to support balance in infants while they are playing in upright. Infants who wore SMOs spent more time with 2 hands on the support surface than infants who did not wear SMOs. However, both groups increased the time they spent with single hand support over time and eventually stood independently to play.

CLINICAL RELEVANCE: Orthoses may be appropriate for infants with DS when therapeutic goals include decreasing the time spent in supported stance.

CONGENITAL MUSCULAR TORTICOLLIS: EFFECTIVENESS OF PHYSICAL THERAPY ALONE INITIATED AFTER ONE YEAR OF AGE

R. Mc Donald

PURPOSE/HYPOTHESIS: It is concluded in previous research by Canale et al. that torticollis will not resolve after age one, and “non-operative therapy after the age of one is likely to be unsuccessful”. Treatment of children with a diagnosis of congenital muscular torticollis (CMT) varies from institution to institution, however the literature tends to support sternocleidomastoid (SCM) release in infants over the age of one^{1,2,3}. No published studies were found that supported or assessed the outcomes of physical therapy alone in the treatment of patients over the age of one with CMT. At our institution children over the age of one are sometimes referred for physical therapy prior to pursuing surgical intervention. This study was undertaken to determine if physical therapy alone can be an effective treatment for CMT when initiated after one year of age.

NUMBER OF SUBJECTS: Fifteen children (6 female, 9 male) were chosen retrospectively based on the following: 1) age one or older 2) with a diagnosis of CMT 3) who did not receive surgical intervention but participated in physical therapy for the treatment of torticollis. Ages of when physical therapy was initiated ranged from 12 to 29 months.

MATERIALS/METHODS: Institutional review board approval was obtained. A scale for outcome analysis was modified from a study by Morrison & MacEwen⁴. Excellent result: no head tilt and full range of motion Good

result: a persistent mild head tilt only. Poor result: a persistent head tilt and a restriction of range of motion A retrospective chart review was conducted.

RESULTS & CONCLUSIONS: The retrospective chart review documented the following results for physical therapy treatment alone:

Excellent 66.7% (10 subjects - 5 male, 5 female, age 12–21 months)

Good 20% (3 subjects – 3 male, age 18–29 months)

Poor 13.3% (2 subjects – 1 male, 1 female, age 12 months)

This study provides evidence, that resolution of CMT may be achieved solely through physical therapy when initiated after age one.

CLINICAL RELEVANCE: General consensus in current literature agrees that if CMT persists past one year of age, no improvements may be expected from solely non-operative treatment. Findings from this study support that physical therapy treatment of CMT after the age of one can be effective and possibly eliminate the need for surgical intervention.

WHICH FAMILY AND HEALTH SYSTEM CHARACTERISTICS CONTRIBUTE TO CAREGIVER BURDEN AMONG FAMILIES OF CHILDREN WITH SPECIAL HEALTH CARE

B.M. McManus

PURPOSE/HYPOTHESIS: Approximately 14% of children have a SHCN, and the vast majority is cared for at home. Parents assume an informal caregiver role and can experience tremendous financial and time burden. Pediatric physical therapists (PT's) work closely with families of CSHCN and are well positioned to identify and ameliorate caregiver burden. The purpose of this study was to describe socio-demographic and health service characteristics associated with caregiver time and financial burden of parents of children with special health care needs (CSHCN).

NUMBER OF SUBJECTS: The study included 15,891 children with a parent reported developmental disability or delay that affected the child's ability to function at least some of the time. Additionally, compared to similarly aged peers, study children need physical, occupational, or speech therapy *or* have functional limitations; *or* developmental or behavioral difficulties; *or* require additional medical, educational, or developmental services.

MATERIALS/METHODS: Data were obtained from the 2005–2006 National Survey of CSHCN. We created a model that included 3 constructs: *Caregiver Burden*, *Ease of Accessing and Navigating the Health Care System*, and *Unmet Health Care Needs*. These constructs were informed by the International Classification of Function, Disability, and Health; American Academy of Pediatrics

policy on medical homes; Maternal and Child Health Bureau best practice guidelines for family centered care and care coordination, and federal policy governing Special Education. Structural equation modeling was used to model the relationships between the constructs.

RESULTS & CONCLUSIONS: Caregiver burden is moderately prevalent among families of CSHCN. Nearly 25% of families reported some aspect of financial burden and 15% spend more than 6 hours per week providing or coordinating their child's health care. *Ease of Accessing and Navigating the Health Care System* is associated with less caregiver burden ($\beta = -.985$, $SE(\beta) = 0.019$) and there is a positive association between *Unmet Health Care Needs* and *Caregiver Burden* ($\beta = .923$, $SE(\beta) = 0.020$). The largest contributor to *Caregiver Burden* was time that families spent providing care for their child. Not participating in Special Education was the largest contributor to both *Ease of Accessing the Health Care System* and *Unmet Health Care Needs*. Poor and (p=0.0005) non-white families (p=0.08) were more likely to experience caregiver burden, unmet healthcare needs, and difficulty accessing and navigating the healthcare system.

CLINICAL RELEVANCE: Families of CSHCN endure time and financial burden. Initiatives that ensure that families of CSHCN are accessing and navigating the healthcare system and receiving all necessary health services will likely reduce caregiver burden. In particular, participation in Special Education appears to buffer unmet healthcare needs. Pediatric PT's can play an integral role in bolstering service delivery for CSHCN in order to reduce caregiver burden.

PEDIATRIC CONSTRAINT INDUCED THERAPY FOR CHILDREN WITH HEMIPARESIS

K. Montgomery

BACKGROUND & PURPOSE: Individuals with hemiparesis, either congenital or acquired, have limited functional use of their involved upper extremity. Traditional approaches have addressed these functional limitations with inconsistent improvements in function. Based on current theories of neuroplasticity, the constraint therapy model has been shown to be effective in some adult neurological populations using several different clinical protocols. More recently, similar findings have been documented in the pediatric population.

OUTCOMES: The intent of this Case Report is to evaluate the effectiveness of an intensive constraint therapy model on five children with hemiparesis of distinct etiology. Pre-intervention/post-intervention and six month follow-up results on the Pediatric Evaluation of Disability Inventory (PEDI), Australian Hand Assessment (AHA), and the Shriner's Hospital for Children Upper Extremity Evaluation (SHUEE) will be presented. Specifically, the impact on independence in self-care activities, spontaneous use of the involved upper extremity, and bilateral upper extremity function will be evaluated.

DISCUSSION: The implications for these findings are multi-faceted. While current literature has documented some success with short-term intensive therapy models the long-term retention of acquired skills is less evident. In addition, access to these intensive services is limited to higher income families. To improve access for all families through third party reimbursement positive long-term outcomes must be demonstrated. Finally, the relevance of these findings needs to be further explored for integration into clinical practice.

THE RELATIONSHIP BETWEEN BMI AND GROSS MOTOR DEVELOPMENT IN TYPICALLY DEVELOPING 3-5 YEAR OLD CHILDREN

D. Nervik

PURPOSE/HYPOTHESIS: The US prevalence of children overweight or obese stands at an alarming 32% according to The National Health and Nutrition Examination Survey of 2006. Numerous health consequences of obesity have been reported including: an increased risk for cardiovascular disease, asthma, diabetes, sleep apnea, non-alcoholic fatty liver disease, and numerous orthopedic complications such as Blount's Disease, slipped capital femoral epiphysis, spinal dysfunction, and an increased risk of fracture. Few studies have been done to examine the relationship between obesity and gross motor development which is an important health component to children's lives. The purpose of this study therefore was to investigate the relationship between obesity and gross motor development in typically developing children. It was hypothesized that gross motor delay would increase as BMI increased.

NUMBER OF SUBJECTS: 50

MATERIALS/METHODS: This study received approval from the University of Indianapolis Institutional Review Board. A sampling of convenience of children ages 3-5 years in a community daycare was used. Children with medical or health conditions that would affect their gross motor development were excluded from the study. Height and weight measurements were taken and BMI calculated (kg/m²). Subjects were categorized into overweight/obese or non-overweight/obese groups. Gross motor development was assessed using the Peabody Developmental Motor Scales, edition 2 (PDMS-2). Gross Motor Quotient (GMQ) scores were categorized using the GMQ categories per PDMS-2 manual. Biserial correlation coefficient and stepwise hierarchical linear regression analysis were used to examine the relationship between these two variables.

RESULTS & CONCLUSIONS: 50 subjects, 26 male and 24 female, ages 3-5 years participated in the study. 24% (12 subjects) were found to be in the overweight/obese category while 76% (38 subjects) were found to be in the non-overweight/obese category. Seven out of the 12 overweight/obese subjects (58%) scored in the below average category on the PDMS-2 compared to the 6 out of 38

non-overweight subjects (15%). A fair correlation ($r = -.37$) was identified with significance of < 0.01 . This inverse relationship shows that as BMI levels increase (to the level of overweight and obese categories), gross motor skills decline. Regression analysis did not indicate a significant predictive relevance for BMI to determine gross motor skill. Additional research is needed to examine this relationship.

CLINICAL RELEVANCE: As health care practitioners who assist in efforts of health promotion and prevention, the findings of this study have significant clinical relevance for physical therapists. Increasing public awareness that gross motor delay may be considered another possible risk of overweight/obesity in children may assist in the efforts to prevent or decrease this serious health issue facing the US.

GAIT TRAINER USE IN NATURAL AND SCHOOL AND CLINICAL ENVIRONMENTS

G. Paleg

PURPOSE: To determine how gait trainers are being used in natural, school and clinical settings. **Description:** This report consists of four components: a systematic review of gait trainers, a survey of 135 therapists, gait analysis of 5 subjects who used at least 2 different models of gait trainers, and three case studies. For the gait analysis, parameters were compared within subjects to produce a descriptive case series. All above information was put together to make specific recommendations for protocols, measurable achievable outcomes and evidence based practice patterns for use of gait trainers in home, school and clinical environments for children with gross motor dysfunction and developmental delays.

SUMMARY OF USE: A systematic review revealed moderate support for body weight support treadmill training for children in clinical settings. Only a handful of studies using gait trainers or over ground use of a PWBTT device were located, and these were generally of low quality (CEBM IV and V). The survey, gait analysis and case studies conducted for this report demonstrate that practitioners are using these devices, and have similar protocols and outcomes. These results indicate that more research is needed to assist clinicians in developing, designing and assessing the use of gait trainers in natural and school environments.

IMMEDIATE AND CARRY-OVER EFFECTS OF THERAPEUTIC MUSIC ON LOADED SIT-TO-STAND MOVEMENT IN CHILDREN WITH SPASTIC DIPLEGIA

Y. Peng, T. Lu, Y. Chen, T. Wang, K. Lin, P. Tang, H. Liao

PURPOSE/HYPOTHESIS: Purpose was to investigate immediate and carry-over effects of Patterned Sensory

Enhancement (PSE) music on the execution of the loaded Sit-to-Stand (STS) movement in children with spastic diplegia (SD). We hypothesized there were immediate and carryover effects of PSE music on children's motivation to perform repeated loaded STS movements, peak knee extensor power, and motor control for children with SD and GMFCS I-III. **Number of Subjects:** A convenience sample of 17 children with SD aged 5 to 12 years and GMFCS I-III were recruited from medical centers, local hospitals and rehabilitation clinics in northern Taiwan.

MATERIALS/METHODS: The digital video, and the motion analysis system and the Intrinsic Motivation Inventory-Chinese version (IMI-C) were used to collect data. The experiment took 2 separate days within 2 weeks to accomplish. On the first day, the 1-Repetition Maximum (1-RM) STS load of each time was determined. The movement performances of the 50% 1-RM load of the STS movement were recorded by video. Then the physical therapist and the music therapist analyzed the components of the individualized PSE according to the performance of each child in the video. The music therapist composed an individualized PSE music file for each child for the second day's study. On the second day, children conducted the loaded STS movement with 50% 1-RM load repetitively for 8 trials in Music and No-music (control) conditions assigned randomly and the kinematic and kinetic data and the IMI-C were collected. In Music condition, PSE music played only in the first 5 trials as the PSE condition, and music was then switched off in the last 3 trials as the Continuation condition. The parameters included: the peak extension power of lower extremities, parameters of motor control (the smoothness, the movement time, the maximal trunk flexion angle) and scores of the IMI-C. Paired *t* or Wilcoxon signed rank test was used to compare the parameters between the PSE and control conditions for immediate effects analysis and between the Continuation and the control conditions for the carry-over effects of the PSE music. α was set at 0.05 (two-tailed).

RESULTS & CONCLUSIONS: During the loaded STS movements, comparing with the control condition, the PSE music showed higher knee peak extension power ($p = 0.042$), better motor control (better center-of-mass smoothness ($p = 0.009$), decreased movement time ($p = 0.006$), and higher IMI-C scores ($p = 0.002$). The carry-over effects of the PSE music were not significant. We concluded that the PSE music with the loaded STS movement could alter motivation, peak extension power, motor control immediately; however, the effects on extension power and motor control could not last once the music was switched off. **Clinical Relevance:** Music might be used to increase the exercise motivation, force output and motor control during resistance exercises for children with cerebral palsy.

DETERMINANTS OF ELEMENTARY SCHOOL PARTICIPATION FOR STUDENTS WITH CEREBRAL PALSY: A SYSTEMATIC REVIEW

B. Pratt

PURPOSE/HYPOTHESIS: To review research that examined the school participation of children with cerebral palsy, in order to understand the extent of participation and factors that influence participation.

NUMBER OF SUBJECTS: Not applicable.

MATERIALS/METHODS: The literature was searched using electronic databases and reference lists from 1990 to 2009. The International Classification of Function (ICF) was used to examine how the school participation of children with cerebral palsy can be influenced by the interaction between their health characteristics and contextual factors.

RESULTS & CONCLUSIONS: Results: As the ICF predicts, the school participation of the child with cerebral palsy can be affected by one or more ICF components. The participation of children with cerebral palsy in the routines of school was more restricted compared to their typically developing peers. Greater participation restriction was associated with increasing severity of impairment, activity limitation, and age with the exception of social participation. The presence of cerebral palsy alone was associated with restricted social participation especially in girls. For the child with severe disabilities, placement in the general education classroom resulted in greater social participation when compared to the segregated classroom. The use of assistive technology improved school participation. The use of assistive technology can be limited because of inadequate training of school staff, teacher attitudes, as well as inappropriate selection and maintenance of technology. An additional barrier to its use is the time requirements needed to use the assistive technology in each setting. Educational assistants are frequently provided for children with cerebral palsy in the school setting to support their education. The type, amount, and method of assistance can positively or negatively influence educational and social participation and the child's self-determination. Other environmental factors that influence school participation were the physical environment (stairs, uneven surfaces, crowding, furniture heights), natural environment (weather, temperature, noise, and other distractions), and educational systems (school routines, productivity demands, placement). Lack of knowledge, understanding, and poor communication between education and health care providers were also cited as barriers to participation.

Conclusion: In the literature reviewed, the participation of children with cerebral palsy is limited when compared to typically developing peers. Logically the intrinsic health components of the child have a primary influence on the child's participation. Less clear is the contribution of contextual factors - environmen-

tal and personal factors - to the development of these participation restrictions.

Clinical Relevance: Improving participation of children with cerebral palsy is an importance outcome in the practice of pediatric rehabilitation. Current knowledge of how a child's interactions with various environments influence participation can affect care provision to children with cerebral palsy.

BEYOND TOUCH: A RELATIONSHIP BASED APPROACH TO PHYSICAL THERAPY

S. Rabinowicz

PURPOSE: To design an educational program that represents an interdisciplinary approach to physical therapy services in early intervention. Knowledge of infant and family development and the importance of relationships during an infant's first three years of life have the potential for improving not only the delivery of PT services but outcomes as well. Providing physical therapy services for the birth to three population requires knowledge and skills that are discipline specific, as well as interdisciplinary. The effectiveness of the practitioner's treatment strategies and interactions relies on the ability to integrate global knowledge with discipline specific training. Incorporating an interdisciplinary understanding of infant and family development to the PTs core of knowledge is reflective of changes in the healthcare environment.

DESCRIPTION: Through an educational process of didactic work, active learning, group discussions, and recommended readings the physical therapist will have the opportunity to study the following topics: transition to parenthood, the infant's first social relationship, non-verbal communication, behavioral states and cues, infant mental health, social-emotional development, self-regulation, autonomy, attachment, and temperament. The PT will be exposed to a variety of professionals from the fields of neuroscience, psychology, infant mental health, developmental psychology, physical and occupational therapy. The material examines the bi-directionality between social-emotional development and movement. The PTs attention is focused on the developing and ongoing relationships (infant/parent, infant/therapist, parent/therapist) that are encountered while providing EI services.

SUMMARY OF USE: Physical therapists partner with the child and parent to maximize abilities that will enable the child to engage, interact and explore. Just as a child is learning and growing within the context of family and environment, the PT is practicing within the context of natural environment and family structure. Interventions may become more effective when the PT has an understanding of infant and family development. As physical therapists gain knowledge of social-emotional development and the importance of early relationships, the relevance of the integration of body, mind and emotions (Broberg, Aars, & Beckmak, 2003) will be established.

Creeping is more than a form of locomotion; it enables the child to actively participate in exploration and learning and allows the child to separate from their parent at will. The child who is struggling to maintain an independent sitting position while using arm support may be unsuccessful in signaling to their Mom 'pick me up.' Research from the fields of neurobiological, behavioral and social sciences (Shonkoff and Phillips, 2000) is challenging PTs to embark on a new frontier: how to facilitate the social-emotional development of the infant, through interactions {relationships} and freedom of movement.

OUTCOMES OF A HIGH FREQUENCY TREATMENT MODEL OF PHYSICAL THERAPY SERVICES IN AN INCLUSION PRESCHOOL SETTING: A CASE STUDY

J. Ruge

BACKGROUND AND PURPOSE: The Individuals with Disability Education Act allows for physical therapy to be provided in the school to children with significant safety concerns or delays in gross motor abilities. Prior to the onset of services, an evaluation is conducted to determine whether school-based PT needs exist and if so, to what extent. The service minutes to be provided for a child are determined at least annually and remain in place for a 12 month period. As in any PT setting *how* the service minutes are delivered is a critical component to its success. The purpose of this case report is to describe the outcomes of school-based physical therapy when provided via high frequency treatments (HFT) over a short period of time. HFT is defined as PT sessions on 75% or more of the days the student was present in school.

OUTCOMES: Over 2 months HB received a total of 21 direct treatment sessions (2 weeks, school was not in session). At the completion of the 2 months of HFT, HB's falls had significantly decreased and all goals were met. She was recorded to fall an average of once every three days, an 89% decrease. She continued to present with lower extremity structural abnormalities, however the HFT was not anticipated or intended to significantly alter these deficits. HB's parents subjectively reported her to be falling less at home and in the community as well. At the cessation of direct services, HB was reevaluated as a component of her 3-year reevaluation. The same testing procedures were used as at the time of initial eval. The reevaluation found the following improvements: increased functional leg and trunk strength, negative Trendelenburg sign, decreased falls, and improved PDMS-2 scores. **DISCUSSION:** At the time of initial evaluation, when in an isolated environment HB was able to ambulate independently and safely, and maintain her balance on uneven surfaces. This was contrary to her ambulation performance in the classroom highlighting the correlation of her inattention to her falls. It was hypothesized that with increased muscle strength in the lower extremities HB would have improved ability to self-correct a loss of balance and subsequently reduce the number of falls. A na-

tionwide survey found PT's working in the schools generally recommend treatment frequencies of 1 to 2 times per week (20%–40% of school days). In this case, treatment frequency was increased to 75% of school days, with a treatment time of 15 minutes per session. At the time of evaluation, HB was falling at a frequency of 3 times per day. At the cessation of direct services her fall frequency decreased to 1 time every 3 days. This 89% decrease in falls occurred over a very short time period. Given that the only component of her therapy that was atypical was the increased frequency, this case report suggests that HFT was a contributor to HB's rapid successful outcomes.

HURLER SYNDROME: PHYSICAL THERAPY MANAGEMENT POST CORD BLOOD TRANSPLANT

D.G. Sole

BACKGROUND & PURPOSE: Mucopolysaccharoidosis (MPS) describes a group of lysosomal storage diseases characterized by enzyme deficiency resulting in defective metabolism of glycoaminoglycans, causing progressive damage in various tissues and premature death, usually by ten years of age. Treatment options for children diagnosed with Hurler Syndrome are limited; however, there is growing evidence that cord blood transplantation may halt disease progression. The purpose of this case report is to describe long-term physical therapy management of a child post cord blood transplant who suffered many secondary complications.

OUTCOMES: Post-transplant complications caused the child to become severely debilitated. The child, who is now four and a half years-old, participated in physical therapy and a home program over a two year period to address the musculoskeletal and soft tissue impairments that were the combined result of disease, transplant and secondary infection. The child is now ambulating independently and is attending pre-school regularly.

DISCUSSION: Physical therapists who are working with children who have undergone transplant must understand the complications that can occur during the transplant process, but also how disease related impairments may contribute to physical therapy outcomes.

ROAD TO PRESCHOOL SUCCESS, THE IMPORTANCE OF EARLY INFANT MOTOR MILESTONES

J. Towne Jennings

PURPOSE: To display a simple, easy to remember motor milestone sequence with photographs, one month to 12 months To propose the connection between each milestone and various motor and academic preschool readiness skills.

DESCRIPTION: Acquisition of motor milestones is important to readiness skills for preschool and later for kindergarten. It starts with the acquisition of core strength

in babies to have adequate pull to sit, and prone extension by 4 months, sitting, rolling and belly crawling by 6 months. This can be presented via poster or slide show. Abnormal behaviors linked to lack of adequate motor milestones will also be presented. I.E. irrational fear of the prone position in 3–5 year old children, excessive clumsiness, problems with short term memory, fine motor delays, speech delays.

SUMMARY OF USE: This is extremely pertinent to the field of physical therapy at this time. Over 1/4 of the normal children I saw in the last 6 years in a public school district preschool program were developmentally delayed both motorically and academically. They could walk, run, and sit. Anything out of vertical was delayed. Core strength was poor for abdominals and flexors. Balance was impacted. Usually speech and fine motor were involved. Some had excessive behavior problems. Family histories indicated that they did not spend much time on flat surfaces and most did not belly crawl. Tummy time before 6 months was lacking. It is important for therapists working in early intervention, preschool, and schools to understand the impact they can have on children if they address the need for early core strength development.

AN INNOVATIVE THERAPEUTIC PROTOCOL FOR CHILDREN WITH CHROMOSOME 22Q11.2 DUPLICATION DISORDER

C.M. Truong

BACKGROUND AND PURPOSE: Pediatric physical therapy commonly involves the treatment and rehabilitation of children with genetic diseases and related physical and cognitive pathologies. Pediatric patients with genetic disorders often display a broad spectrum of developmental delays and psychomotor limitations. Such illnesses can present significant challenges for therapists and other caregivers seeking to enhance patient quality of life. In this preliminary study, we examined a 35 month old, Caucasian patient with a rare chromosomal anomaly, 22Q11.2 duplication disorder. Pediatric patients with this genomic duplication often display limited cognition, delayed psychomotor development, growth retardation, and hypotonia. These patients present significant challenges to therapists due to their limited attention span, cognitive and developmental immaturity, and distractible focus on environmental awareness and spatial perception.

CASE DESCRIPTION: Observations of patient psychomotor function were made in an outpatient pediatric physical therapy clinic during weekly therapy sessions over a six week period. Assessments of patient psychomotor skills and therapeutic challenges were documented and subsequently compared to a non-chromosome 22Q11.2 duplication individual of similar age, gender, and ethnicity. In the child with the chromosome duplication, a prominent lack of balance and constant focus on spatial awareness significantly hindered locomotion,

unsupported sitting, and consistent participation in classic physical therapy protocols.

OUTCOMES: In an effort to improve patient attention span and therapeutic participation, a dance-based intervention, targeted at balance control and spatial orientation, was designed. Central to the therapeutic design was a need for child-friendly routines that could be implemented in non-clinical settings, by non-therapists, at minimal expense. Key components of the dance-based therapeutic regime included progressive child-motivating movement activities, repetitive beat-emphasizing music, child-friendly musical instruments, and colorful pom-poms. Each of these activities was designed to enhance balance and proprioception. Implementation of the dance and music based intervention appeared to captivate both study participants and improve therapy participation.

DISCUSSION: While therapeutic time constraints limited full implementation of the dance-based therapy, preliminary observations of this child-friendly intervention showed potential promise as an additional therapeutic strategy for children suffering from 22q11.2 duplication and a wide variety of balance-limiting disorders. This approach has the potential to be incorporated into a broad spectrum of settings, including natural environments such as the home, day-care facilities, schools, and physical education classes.

DISTRIBUTION OF IMPAIRMENTS BY GROSS MOTOR FUNCTION CLASSIFICATION AND AGE IN YOUNG CHILDREN WITH CEREBRAL PALSY

S. Westcott McCoy

PURPOSE/HYPOTHESIS: Children with cerebral palsy (CP) have primary impairments in muscle tone and postural control. Secondary impairments develop over time, including altered range of motion and force production. The overall distribution of primary and secondary impairments and the development of secondary impairments among young children with CP are not fully understood. We developed a set of clinical tests to describe primary and secondary impairments. The purposes of this presentation are to describe the distribution of primary (muscle tone, postural control) and secondary impairments (strength and range of motion) in young children with CP across Gross Motor Function Classification System (GMFCS) levels and age, and verify the reliability of the new strength test.

NUMBER OF SUBJECTS: This was an exploratory cohort design. The sample (~50% male) included 125 to 255 children with CP, depending on the test, ranging in age from 17 to 58 months, from 6 provinces in Canada and 4 regions in the USA. The reliability sample for the strength test included 28 children with CP from 2 USA regions. All testing took place in participants' homes or health care facilities.

MATERIALS/METHODS: The following tests were given to the children: Muscle tone, Modified Ashworth Scale

(MAS); Postural control, Modified Movement Assessment of Infants Equilibrium section (MMAI) for children with GMFCS Levels III, IV, V, and Pediatric Balance Scale (PBS) for children with GMFCS levels I, II, III; Range of motion, Spinal Alignment and Range of Motion Measure (SAROMM); and strength, a modified Functional Strength Assessment (FSA) that we created. Data were collected by trained raters, who passed criterion-based reliability checks for all tests except the MAS and FSA, prior to data collection. Descriptive data were analyzed across GMFCS levels for both primary and secondary impairments and across age for secondary impairments (as a proxy to explore change over time). Data were analyzed using one-way ANOVAs to determine differences between GMFCS and age levels, and correlations to examine relationships between primary and secondary impairment development. The ICC (2,1) was used to estimate strength interrater reliability.

RESULTS & CONCLUSIONS: Significant differences were found between all tests across GMFCS levels. As functional level decreased, primary and secondary impairments increased in the children. No differences were found due to age, except on the PBS where scores improved with age. Correlations between primary and secondary impairments ranged from $r=0.47$ to 0.73 , with the highest correlation between MMAI and strength scores and lowest between both balance scales and MAS scores. Inter-rater reliability was supported for the strength measure (ICC[2,1] = .996, 95% CI .991-.998).
CLINICAL RELEVANCE: Our description of primary impairments and the development of secondary impairments should assist therapists in formulating appropriate plans of care. This set of tests is practical and has sufficient reliability for use in clinical and research settings.

CEREBRAL BLOOD FLOW PARAMETERS OF TERM AND PRETERM INFANTS AT TERM AGE AND THEIR RELATIONS WITH DEVELOPMENTAL OUTCOMES

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PURPOSE/HYPOTHESIS: The aim of this study was twofold: (1) to examine the cerebral blood flow parameters in term and very low birth weight (VLBW) preterm infants (birth weight < 1,500 g) who had no major brain damage at term age using cranial Doppler ultrasound;

and (2) to assess the relations of the cerebral blood flow parameters with subsequent developmental outcomes in these infants.

NUMBER OF SUBJECTS: 58 term infants and 165 VLBW preterm infants.

MATERIALS/METHODS: Infants were prospectively administered cranial Doppler ultrasound examination at term age and the Bayley Scales of Infant and Toddler Development- 3rd edition at 6 and 12 months corrected age. Blood flow parameters examined for bilateral middle cerebral arteries (MCAs) included the peak systolic velocity (PSV), end diastolic velocity (EDV) and resistance index (RI). Developmental outcome measures included the cognitive, language and motor composite scores.

RESULTS & CONCLUSIONS: In comparison to term infants, VLBW preterm infants showed higher PSV, EDV and RI values in bilateral MCAs at term age, followed by poorer cognitive, language and motor performance at 6 months corrected age and then poorer cognitive and motor performance at 12 months corrected age (all $p<0.05$). Among term infants, a lower RI value in the left MCA was associated with a higher language score at 6 and 12 months corrected age ($r=-0.30$ and -0.29 , both $p<0.05$), whereas a higher velocity value (PSV or EDV) in the left MCA was associated with a higher motor score ($r=0.28$ and 0.31 , $p<0.05$). Furthermore, larger differences between the velocity values between bilateral MCAs were associated with a higher motor score at 12 months corrected age ($r=0.33$ and 0.43 for PSV and EDV, respectively). Among preterm infants, a lower PSV value was correlated with a higher cognitive score at 12 months corrected age ($r=-0.23$, $p<0.05$). Our results demonstrated that cranial Doppler ultrasound was sensitive to detect the difference of cerebral hemodynamics between term and VLBW preterm infants in the neonatal period and certain measures were predictive of developmental outcomes.

CLINICAL RELEVANCE: VLBW preterm infants without severe neonatal brain damage showed altered cerebral hemodynamics at term age and poorer developmental outcomes compared with their term peers. The mechanisms underlying the different correlation pattern between cerebral hemodynamics and developmental outcome require further investigation.