A Fitness Program for a 4-Year Old Child with Spina Bifida Myelomeningocele that utilizes an AmTryke* Therapeutic Tricycle Combination Hand/Foot Drive

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ABSTRACT

Study Design:
Case Report

Background/purpose:
Spina bifida is the most common permanently disabling birth defect in the United States. Children with spina bifida myelomeningocele exercise less and spend more time in sedentary activities than typically developing peers. Fitness programs for children with disabilities are limited. The purpose of this case report was to describe a fitness program for a 4-year old child with spina bifida myelomeningocele that utilizes an AmTryke therapeutic tricycle with combination hand/foot drive.

Case description:
The child was a 4-year old female with diagnoses of L4-L5 level myelomeningocele.

Outcome:
The following outcomes were measured: energy expenditure index (EEI) with the child walking with reverse walker and propelling a manual wheelchair; 6 minutes walk test (6MWT) with reverse walker; manual muscle test (MMT) of iliopsoas, gluteus medius, gluteus maximus, quadriceps, and anterior tibialis; sit-up performance; sit and reach test; body mass index; modified functional reach test (FRT) in sitting and standing; and the *Pediatric Evaluation of Disability Inventory* mobility domain. The case report noted improvement in EEI for walking and wheelchair mobility, 6MWT, sit-up performance, sit and reach test, modified FRT in standing and sitting, and PEDI mobility domain scores.

Discussion:
The results of the 6-week intervention case report suggests that a 4-year old child with spina bifida myelomeningocele can benefit from a fitness program that utilizes a therapeutic tricycle combination hand/foot drive

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INTRODUCTION

Myelodysplasia, commonly referred to as spina bifida, is a neural tube defect involving the spinal structures secondary to abnormal closure of the neural tube during the first month of pregnancy. Spina bifida is the most common permanently disabling birth defect in the United States affecting over 70,000 people. {{45 Spina Bifida Association 2004}} Myelomeningocele, the most serious type of spina bifida, occurs when the meninges and spinal nerves come through the open part of the spine.

A challenge for preschool children with myelomeningocele is to have a fitness program that is practical, motivating, and beneficial. Children with spina bifida exercise less and spend more time in sedentary activities, a known risk factor for obesity, than children with no disabling conditions. {{24 Gannotti, M. 2007; 52 Woodhouse, C. 2008}} Fifty percent of children with spina bifida beyond the age of 6 years are overweight and 50% of adolescents and adults with spina bifida are obese. {{45 Spina Bifida Association 2004}} Obesity is a risk factor for coronary artery disease, hypertension, diabetes mellitus, osteoarthritis, sleep apnea, and psychological problems. Fitness is adversely affected by the challenges to mobility children with spina bifida face.

Only 7% of typically developing children obtain the recommended level of 60 minutes of moderate to vigorous physical activity daily. {{47 Cardon, G. M. 2008; 44 Office of Surgeon General 2001; 42 Center for Disease Control 2008; 10 Barclay, L. 2005}} A review of measurement studies indicates that preschool age children have a high level of inactivity and low level of vigorous activity. {{30 Oliver, M. 2007}} The *Healthy People 2010* initiative states people with disabilities are less likely to participate in vigorous or sustained exercise as compared to people without disabilities and the initiative focuses on two major goals: increasing the years and quality of life of healthy living; and eliminating the disparities in health among different racial and ethnic groups, including disparities between the disabled and non-disabled population. When coupled with dietary factors, physical inactivity is the second leading cause of preventable deaths in the United States, resulting in over 300,000 deaths each year. {{46 Centers for Disease Control and Prevention and National Institute on Disability and Rehabilitation Research 2002}} Involving a child with a disability in a fitness program aimed at establishing lifelong promotion of good health can decrease the adverse effects of inactivity and decreased fitness while promoting physical and emotional well-being. {{54 Darrah, J. 1999; 53 Ekeland, E. 004; 84 Rimmer, J. 1999; 19 Fragala-Pinkham, M.A. 2005; 46 Centers for Disease Control and Prevention and National Institute on Disability and Rehabilitation Research 2002}}

The American Physical Therapy Association (APTA) defines fitness as a dynamic physical state in which a person can optimally and efficiently participate in daily and leisure activities. Components of fitness include cardiovascular/pulmonary endurance, muscle strength, power, endurance, flexibility, relaxation, and body composition. {{61 American Physical Therapy Association 2001}} The 4 health-related fitness components include cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition. {{85 Campbell, S.K. 2006}} Children with disabilities often can not participate in community activities with typically developing peers. Twice weekly strength and endurance training program may demonstrate positive changes in fitness for children with disabilities. {{19 Fragala-Pinkham, M.A. 2005}}

The promotion of lifelong habits of physical activity in childhood directly and indirectly impact health and disease prevention in adulthood. {{85 Campbell, S.K. 2006}} Physical therapists can have a significant impact on the exercise lifestyle children develop and sustain through life and the opportunities for children with disabilities to participate in fitness activities needs to shift from the medical setting to the community setting. {{55 Fragala-Pinkham, M.A. 2006}}

The collaborative model of physical therapy service delivery using evidence-based decision making is family-centered, involves the opportunity for motor learning incorporated into daily activities and routines, and facilitates outcomes that are meaningful to the child and family in daily life. {{31 Palisano, R.J. 2006}} Tricycle riding is an age-appropriate family-centered activity for a preschool-aged child that is practical to incorporate into a family's routine and the child's natural learning environment. Customized tricycles have been shown to facilitate positive gains in muscle mass, strength, coordination, and confidence in children with osteogenesis imperfecta III. {{21 Geu, M. 2006}} The American Heart Association recommends that communities provide safe walking and bicycling routes to school and schools promote use of the routes. {{43 Pate, R.R. 2006}}

The purpose of this case report was to describe a fitness program for a 4-year old child with spina bifida myelomeningocele that utilizes an AmTryke therapeutic tricycle combination hand/foot drive.

CASE DESCRIPTION

History and Examination

A.L. was a 4-year-old female at the time of evaluation, 36" tall and weighs 35 pounds, and has the following diagnoses: L4-L5 level myelomeningocele, Arnold Chiari type II malformation, and shunted hydrocephalus.

Surgery was performed for repair of tethered spinal cord in the lumbar region and Arnold Chiari type II malformation decompression at twenty-seven months of age. A.L. initiated independent walking short distances with a forward walker at 36 months of age at which time her parents voiced concern about her lack of motivation for mobility and significant anxiety in stance position.

A.L. participated in physical therapy once a week privately and once a week through the public school system's early childhood program as outlined in her Individualized Educational Plan (IEP). She wore bilateral ground reaction ankle foot orthotics, had a manual wheelchair as primary means of mobility, and used a reverse rolling walker for short distances. A.L.'s mother provided informed consent before participation in this study.

Physical therapy gait assessment findings included reciprocal gait with occasional swing-through gait with the reverse walker. A.L. demonstrated the following gait deviations: forward trunk lean; increased thoracic kyphosis; increased stance phase hip abduction left greater than right; increased stance phase knee flexion; excessive left hip external rotation; left leg crossing midline in stance phase 50% consistency with circumduction of right leg to clear left leg; narrow base of support; and significant use of upper extremity weight bearing. She walked in a straight path and independently maneuvered around obstacles. She was unable to step over obstacles greater than 2" or maneuver up or down single steps or steps with rails. Slow cadence observed during ambulation with inability to maintain walking pace of peers and notable difficulty over uneven terrains. She was motivated to walk despite decreased endurance and quickly fatiguing. She demonstrated skillful use of manual wheelchair on level surface, around obstacles, and kept pace with peers during 2 1/2 hour preschool session 3 times per week. She was able to transfer wheelchair to floor independently and floor to wheelchair with moderate manual assistance and verbal cues. A.L. exhibited kyphoscoliosis.

Tests and Measurements

A.L.'s primary diagnosis of spina bifida myelomeningocele placed her in the APTA's *Guide to Physical Therapy Practice Neuromuscular Preferred Practice Pattern C: Impaired Motor Function and Sensory Integrity Associated with Nonprogressive Disorders of the Central Nervous System-Congenital Origin.* The *Guide to Physical Therapist Practice* defines fitness as a dynamic physical state that allows optimal and efficient performance of daily and leisure activities. {{61 American Physical Therapy Association 2001}} The components of health-related physical fitness of cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition were assessed pre and post six-week intervention. {{85 Campbell, S.K. 2006}}

Cardiorespiratory Endurance

The following measures were used to assess cardiorespiratory endurance: the Energy Expenditure Index (EEI) while walking with bilateral ground reaction ankle foot orthotics and reverse walker; EEI for wheelchair mobility on level surface; and the six-minute walk test (6MWT). The EEI measures energy efficiency by relating changes in heart rate to wheelchair or ambulation velocity. The EEI in beats/meter was calculated using the formula [(working heart rate - resting heart rate)/ walking or wheelchair velocity (meters/minute)] to derive a ratio of beats per meter. EEI based on heart rate can be used to provide objective information on energy expenditure in the clinical setting. {{69 Rose, J. 1990; 62 Rose, J. 1991}} The higher the EEI number the greater the energy expenditure and lower the energy efficiency. The EEI has been validated in several studies for children with cerebral palsy. {{69 Rose, J. 1990; 62 Rose, J. 1991; 63 Norman, J.F. 2004}} The EEI has been used in a study to determine energy expenditure during wheelchair propulsion. {{83 Mukherjee, G. 2002}} The EEI is an easy to obtain indicator of energy expenditure to assess therapeutic interventions in the clinical environment.

The 6MWT has been shown to be a reliable and valid method to measure walking endurance in children. {{80 Li, A.M. 2005}} The total distance the child can walk for six minutes was recorded in meters. The child walks without running on a level surface in an unobstructed hallway varying speed and resting if needed with encouragement of continued walking as far as possible until the stopwatch shows six minutes. The distance covered was measured in meters and recorded.

Muscle Strength and Endurance

Muscle strength was assessed with manual muscle test (MMT) of iliopsoas, gluteus medius, gluteus maximus, quadriceps, and anterior tibialis. Sit-up performance was used to determine muscle endurance. Sufficient lower-extremity muscle performance is necessary to ambulate and transfer efficiently for the child with myelomeningocele. {{56 Effgen, S.K. 1992}} Muscle strength of the iliopsoas, gluteus maximus, and quadriceps was identified to be predictive of upright mobility for individuals with myelomeningocele. {{66 McDonald, C.M. 1991; 77 Schopler, S.A. 1987}} MMT performed per methodology as described by Kendall. {{79 Kendall, F.P. 2005}}

Sit-ups are used as a field measurement of trunk strength and endurance. Normative data is available on sit-up performance for children 3 to 7 years of age. {{88 Lefkof, M.B. 1986}}

Flexibility

Flexibility was assessed according to the *President's Challenge- Educator* sit and reach test. {{89 President's Council of Physical Fitness}}

Body Composition

Body composition was assessed with the Body Mass Index (BMI). BMI is calculated as [weight (kilogram)/stature squared (meter)2] and is age and sex specific for children and adolescents. Research has demonstrated that BMI correlates to a direct measure of body fat for children and adolescents.{{68 Mei, Z. 2002; 67 Maynard,L.M. 2001}} The American Academy of Pediatrics and the Center for Disease Control recommend the use of BMI for children two years of age and older to screen for overweight and obesity. {{82 Department of Health and Human Services: Centers for Disease Control and Prevention}}

Additional Measures Performed

The modified functional reach test (FRT) was used to assess standing balance and fall risk. The FRT has been show to be a reliable and valid for standing balance and predicting risk of falling in the adult population. {{76 Weiner, D.K. 1993; 75 Duncan, P.W. 1992; 74 Duncan, P.W. 1990}} The FRT was an appropriate test to examine the balance of 4-year-old children. {{70 Norris, R.A. 2008}} The FRT was performed under 2 different conditions. The first method involved the child using the walker to maintain support through her non-dominant hand while performing FRT with her dominant arm. The second method included the child sitting on firm seat chair with feet flat on support surface. Research was not available on modified version of FRT for a 4-year old child.

Measures of functional mobility were performed using the *Pediatric Evaluation of Disability Inventory* (PEDI) using the mobility domain of the functional skills part. {{81 Haley, S.M. 1992}} The PEDI is a standardized pediatric evaluative instrument used to monitor individual progress and evaluate functional change in pediatric rehabilitation programs for a variety of diagnoses including spina bifida. {{64 Tsai, P.Y 2002}} The mobility domain functional skills scale assesses the child's ability to perform mobility activities that are considered to be part of important daily functional skills and independence in mobility function. {{81 Haley, S.M. 1992; 73 Haley, S.M. 2001}} Elements of the functional mobility content domain include functional outcome measure of basic transfer skills (getting in and out of bed, chair, toilet, tub/shower, and car) and body transport activities (floor mobility, locomotion indoors and outdoors, use of stairs, negotiation of outdoor surfaces and ramps, and carrying and manipulating objects during locomotion) which incorporate distance, speed, and safety. {{81 Haley, S.M. 1992}}

Interventions

The fitness program was six weeks long and consisted of riding a therapeutic tricycle twice a week for 30 minutes.

The AmTryke Therapeutic Tricycle utilized featured continuous chain mechanism for hand/foot movement, self-righting pedals with heel and instep hook and loop straps, 4-way adjustable seating, seat back, and seat belt. {{78 National AMBUCS, Inc. / AmTryke, LLC 2009}} A tricycle with hand/foot drive was chosen because A.L. was unable to propel a foot drive only tricycle. (Figure 1)

The intensity of the tricycle riding during the 30 minute session was increased as amount of physical assistance to propel the tricycle was decreased. A.L. required maximal assistance to propel the tricycle in sessions 1 and 2 decreasing to minimal assistance in sessions 5 through 12. Tricycle riding occurred on level surfaces of one block sidewalk route outside or long rectangular hallway route inside dependent on weather.

Outcomes

Cardiorespiratory Endurance

An inefficient gait pattern, lower walking velocity, and significantly higher oxygen cost per meter walked has been demonstrated in children with myelomeningocele as compared to children without a disability. {{17 Duffy, C.M. 1996}} EEI with A.L. performing reciprocal steps with a reverse walker decreased from 12.88 beats per meter to 3.49 beats per meter (73% change) at the end of the 6-week intervention. The EEI for propulsion of a manual wheelchair decreased from 0.75 beats per meter to 0.47 beats per meter (37% change) at the end of the 6-week intervention. The changes in EEI suggest that A.L. was able to walk with a reverse walker and propel a manual wheelchair with decreased energy requirements and increased efficiency at the end of the 6-week intervention. The 6MWT with A.L. using reverse walker to take reciprocal steps increased from 33.53 meters to 48.16 meters (44% change) indicating an increase in cardiorespiratory endurance at the end of the 6-week intervention. (Table 1).

Muscle Strength and Endurance

~~The ability to ambulate and transfer efficiently for the child with myelomeningocele requires sufficient lower-extremity muscle performance. {{56 Effgen, S.K. 1992}}Muscle strength of the iliopsoas, gluteus maximus, and quadriceps was identified to be predictive of upright mobility for individuals with myelomeningocele. {{66 McDonald, C.M. 1991; 77 Schopler, S.A. 1987}}The strongest predictor of ambulation was the iliopsoas strength followed by the quadriceps, anterior tibialis, and glutei. {{66 McDonald, C.M. 1991}} Research has demonstrated the following: partial or complete reliance on a wheelchair occurred with grade 0-3/5 iliopsoas strength; community ambulators with occasional wheelchair use occurred with grade 4-5/5 iliopsoas and quadriceps strength; and community ambulation without aids or braces occurred with grades 4-5/5 gluteal and anterior tibialis strength. {{66 McDonald, C.M. 1991}}~~A.L.'s MMT changed only in right anterior tibialis from 1/5 to 2-/5 from pre to post 6-week intervention. (Table 2) A.L.'s sit-up performance increased from 1 to 6 (500% change). (Table 1) Improved sit-up performance indicates an increase in trunk strength and endurance at the end of the 6-week intervention.

Flexibility

Sit and reach test increased from 6.35cm to 10.16 cm (60% change) indicating an increase in flexibility after 6-week intervention. (Table 1)

Body Composition

BMI decreased from 19.0 to 18.2 (4% change) continuing to place child above the 95% for both pre and post assessment. (Table 1) Although BMI correlates to a direct measure of body fat for children and adolescents, BMI can only be used as a screening tool.

Additional Measures Performed

Sitting FRT increased from16.51 cm to 17.78 cm (8% change) and standing FRT increased from 10.16 cm to 15.24 cm (50% change) indicating a possible increase in standing balance and decreased risk of falling after 6-week intervention. The PEDI-mobility functional skills increased from scaled score of 44.3 to 53.9 (22% change) after 6-week intervention. (Table 1) A.L. demonstrated improvement in the following skills: the ability to transfer in and out of her wheelchair; independence with fasten and unfasten her seatbelt; the ability to pull and carry small objects while in her wheelchair and while walking with her reverse walker; and the ability to walk with a reverse walker outside on rough, uneven surfaces and up and down inclines or ramps.

Discussion

Children with disabilities have limited opportunities to participate in fitness programs.{{91 US Dept of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion 1999}} Fitness programs that are available for children with disabilities are often group based at scheduled times in specific locations. The reason for success and safety of the programs are also the challenges which include: having a high adult-to-child ratio; having trained adults available to implement the program; and finding an accessible environment. The social component of group exercise appears to be motivational contrasting low compliance with home based exercise programs due to lack of motivation. {{19 Fragala-Pinkham, M.A. 2005}} A.L. was highly motivated and engaged throughout the entire 6-weeks as observed by readily participating in each session and disappointment when each session ended. The reason for motivation could include: the novelty of the activity since she observed peers riding tricycles during most preschool session and previously could not participate with her peers due to lack of an accessible tricycle; the one-on-one interaction with an adult during each session; and the frequent verbal praise that occurred from peers, staff, and parents who observed her riding the tricycle.

Data presented in other research on the benefit of fitness programs for children with disabilities support the data presented in this case report including changes in cardiorespiratory endurance, strength and endurance, flexibility, and body composition. Available research addressed community group fitness programs, hospital based group fitness program, and home exercise programs including strength training and aerobic conditioning. {{55 Fragala-Pinkham, M.A. 2006; 19 Fragala-Pinkham, M.A. 2005; 37 Schreiber, J. 2004; 90 Lewis, C. 2005}} Research was not available on the effects of community based fitness activities for preschool-aged children with disabilities or the effect riding a tricycle has on fitness of a child with a disability. A benefit of providing a fitness program of riding a therapeutic tricycle for a child with a disability is the parent or caregiver requires minimal to no specialized training and the activity is a typical activity for many families and preschool-aged children which can be incorporated into the child's routine.

Fitness program studies vary in frequency and duration with the majority 20 to 60 minutes per session 2 to 3 times per week for 6 to 10 weeks. {{54 Darrah, J. 1999; 55 Fragala-Pinkham, M.A. 2006; 19 Fragala-Pinkham, M.A. 2005; 90 Lewis, C. 2005; 101 Sallis, J.F. 1997; 102 Weipert, S. 1998; 103 American College of Sports Medicine 2000}} The fitness program needed to be reasonable and manageable to implement in

A.L.'s routine in a community setting, therefore 30 minutes twice a week for 6 weeks was chosen.

Cardiorespiratory endurance is an important component of health related fitness. Research has shown that children with spina bifida have a diminished aerobic capacity as compared to typical peers and that cardiorespiratory endurance is no less important in children with disabilities as compared to typical peers. {{86 Agre, J.C. 1984; 93 Goldberg, B. 1990}} A.L.'s cardiovascular endurance improved as noted by decreased value of EEI for both walking and wheelchair propulsion and increased distance for 6MWT. Previous research noted EEI has improved with participation in a fitness program for children who had a baseline EEI below normal. {{19 Fragala-Pinkham, M.A. 2005}} Average self-selected comfortable floor walking EEI is 0.47beats/meter for children and EEI is not age related. {{62 Rose, J. 1991; 91 Bulter, P. 1984}} A.L. exhibited EEI for walking with reverse walker taking reciprocal steps pre intervention 12.88beats/meter and post 3.49 beats/meter with a 73% change. Post intervention, A.L. used her walker more frequently for longer distances in the preschool environment possibly due to improved cardiorespiratory endurance.

Children with disabilities demonstrate decreased muscle strength as compared to typical peers and have shown improvement in muscle strength and endurance through participation in group fitness programs. {{19 Fragala-Pinkham, M.A. 2005}} A.L. improved in her ability to perform trunk strength and endurance activity as measured by sit-up performance with 500% change from pre to post intervention. The ability to ambulate and transfer efficiently for the child with myelomeningocele requires sufficient lower-extremity muscle performance. {{56 Effgen, S.K. 1992}}Muscle strength of the iliopsoas, gluteus maximus, and quadriceps was identified to be predictive of upright mobility for individuals with myelomeningocele. {{66 McDonald, C.M. 1991; 77 Schopler, S.A. 1987}}The strongest predictor of ambulation was the iliopsoas strength followed by the quadriceps, anterior tibialis, and glutei. {{66 McDonald, C.M. 1991}} Research has demonstrated the following: partial or complete reliance on a wheelchair occurred with grade 0-3/5 iliopsoas strength; community ambulators with occasional wheelchair use occurred with grade 4-5/5 iliopsoas and quadriceps strength; and community ambulation without aids or braces occurred with grades 4-5/5 gluteal and anterior tibialis strength. {{66 McDonald, C.M. 1991}} MMT performed in A.L.'s lower extremity noted change only in right anterior tibialis from 1/5 to 2-/5. Lack of changes in lower extremity strength are likely due paralysis from L4-L5 level of myelomeningocele. The therapeutic tricycle utilized in the case report was hand/foot drive with the child primarily using hand drive for mobility due to lower extremity weakness. A case report has suggested that arm ergometry (hand drive) can be used for physical training in adolescents with myelodysplasia. {{100 Marion, C. 1986}} Upper extremity strength and endurance should be assessed in future research due to the continual arm movement while riding a hand/foot drive tricycle. Upper extremity strength and endurance affect ability to walk with an assistive device and propel a wheelchair. {{94 Janssen, T.W.J. 1994; 95 Opila, K.A. 1987; 96 Minor, M.A.D. 1999}}

A.L. used a wheelchair as primary means of mobility and spent majority of her day in a sitting posture. A study has suggested that children with spina bifida using wheelchairs have decreased flexibility and that the ability to ambulate and lower extremity flexibility have a positive correlation. {{86 Agre, J.C. 1984}} A.L. had decreased flexibility as noted in pre test SRT of 6.35cm increasing to post test of 10.16cm with a 60% change. Limited lower extremity flexibility has been shown to be related to ambulatory status in children with spina bifida: children who walked full-time had minimal contractures; whereas children who never walked had the most contractures. {{86 Agre, J.C. 1984}} A.L.'s increase in lower extremity flexibility may have been associated with riding the tricycle or the increased time she spent ambulating with walker in the preschool environment during the 6 week intervention. Other fitness programs for children have shown inconsistent changes in flexibility. {{37 Schreiber, J. 2004; 54 Darrah, J. 1999; 55 Fragala-Pinkham, M.A. 2006; 19 Fragala-Pinkham, M.A. 2005}}

Body composition, a measure of body fat, was measured using the BMI screening tool. A low level of body fat or lower BMI correlates with a higher level of cardiorespiratory endurance. Children with spina bifida have been shown to have a high level of obesity. {{99 Mia, K. 1993}} A.L.'s BMI decreased from 19.0 pre and 18.2 post intervention with a 4.2% change. BMI is dependent on weight and height and is age and sex specific for children. The changes that occurred with A.L. may have been due to maturation; increased hip flexion flexibility allowing a more accurate height measurement; decreased body fat; or due to increased activity of tricycle riding since a more active child burns more calories and decreases amount of fat stored.

A.L. improved with FRT with an 8% change for sitting FRT and 50% change for standing FRT. The improvement in standing FRT correlates to improved balance and decreased risk of falling. {{70 Norris, R.A. 2008; 74 Duncan, P.W. 1990; 75 Duncan, P.W. 1992; 76 Weiner, D.K. 1993}}

Functional mobility improved for the child as measured by the PEDI-mobility functional skills. Functional improvements have been recorded in other studies on children with disabilities participating in fitness programs. {{55 Fragala-Pinkham, M.A. 2006; 19 Fragala-Pinkham, M.A. 2005}} The intervention incorporated the child transferring in and out of wheelchair and on and off of tricycle as independently as possible and could have also facilitated improvement in functional mobility after intervention.

Changes in outcomes at the end of 6-week intervention could be due to participating in a fitness program of riding a therapeutic tricycle, maturation, physical therapy intervention, or a combination of all the factors. A case report can not establish cause-and-effect relationships between interventions and outcomes. In future studies evaluating the effectiveness of a fitness program utilizing a therapeutic tricycle for children with disabilities, a research design with a control group would be beneficial.

Conclusion

Providing health related fitness opportunities for preschool children can be a challenge especially for a child with a disability. Children with disabilities need to be able to participate in motivating and practical physical fitness activities that can be implemented in the child's natural environment by family and caregivers. Many preschool aged children enjoy riding tricycles in their home environments but often children with disabilities can not ride typical tricycles. Therapeutic tricycles are available and can accommodate a variety of children with disabilities.

This case report supports the use of a therapeutic tricycle to provide a fitness program for a child with a disability. Changes in health related physical fitness of cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition may be possible following a 30 minute twice weekly tricycle riding program.

Future studies incorporating a research design with a control group are needed to determine a cause and effect relationship of tricycle riding on fitness with children with disabilities. Future studies may want to assess health related physical fitness pre and post intervention with the parents and caregivers to determine if walking with the child riding the tricycle affects the parent's or caregiver's physical fitness which might increase motivation for follow through in the home or community environment. Future research is needed on the benefits of tricycle riding for children with disabilities.

Pre and Post 6-Week Intervention Measurements

Measure	Pre Intervention	Post Intervention	% Change
EEI: Reverse Walker/Reciprocal Steps	12.88 beats/meter	3.49 beats/meter	72%
EEI: Manual Wheelchair/Level Surface	0.75 beats/meter	0.47 beats/meter	37%
6MWT: Reverse Walker /Reciprocal Steps (m)	33.53	48.16	44%
Sit Ups performed in 3 minutes	1	6	500%
Sit and Reach Test (cm)	6.35	10.16	60%
BMI	19.0 (97th %) May be obese	18.2 (95th %) May be obese	4%
FRT Sitting (cm)	16.51	17.78	8%
FRT Standing (cm)	10.16	15.24	50%

Table 2

Lower Extremity Muscle Strength Pre and Post Six-Week Intervention

Muscle	Levels	Pre Left	Post Left	Pre Right	Post Right

Iliopsoas	L2-4	2/5	2/5	1/5	1/5
Gluteus Medius	L4-5, S1	0/5	0/5	0/5	0/5
Gluteus Maximus	L5, S1-2	0/5	0/5	0/5	0/5
Quadriceps	L3-4	3+/5	3+/5	3+/5	3+/5
Anterior Tibialis	L4-5	2-/5	2-/5	1/5	2-/5

Figure1. A.L. riding therapeutic tricycle with combination hand and foot drive.