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RESEARCH ARTICLE

TREADMILL TRAINING WITH SUPRAMALLEOLAR ORTHOSIS ON BALANCE IN DOWN SYNDROME CHILDREN

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ABSTRACT

Background: Children with Down syndrome frequently show postponed beginning of independent walking. Treadmill preparing is a compelling intercession that invigorate a prior walking start. In addition, orthosis regularly are given to children with Down syndrome to increase steadiness and advance prior free walking. The purpose of this study was to give knowledge into the formative results of early orthosis use in a mix with treadmill training in children with Down syndrome contrasted with treadmill training alone. **Methods:** Thirty patients in with Down syndrome (age ranges from 7 to 11) years were equally divided into two groups; control group (A) and study group (B). The control group received designated physical therapy program to facilitate balance during walking for one hour, while the study group receiving treadmill exercise with supramalleolar orthosis for twenty-five minutes in addition to the same program which given to the control group for thirty-five minutes were used for treatment in the out-patient clinic of the Faculty of Physical Therapy, Cairo University. **Results:** The results uncovered a measurably critical improvement in the measuring variables of both groups when contrasting their pre and post treatment mean values. Comparing the two groups' post –treatment variables, significant difference is revealed in favor of the study group. **Conclusion:** The obtained results strongly support the introduction of treadmill exercise with supramalleolar orthosis as an additional procedure to the treatment program of Down syndrome children.

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INTRODUCTION

Down syndrome happens in 1 out of each 800 births in the United States. Down syndrome most often outcomes from an additional duplicate of chromosome 21 in the body's cells. By and large, this additional chromosome originates from the mother. At times, types of Down syndrome can come about because of simply having an additional bit of chromosome 21{Angulo-Barroso et al., 2014} .Infants with Down syndrome have specific distinguishing bodily features, for instance short stature, characteristic facial features and are more probable to have health conditions like deafness, heart defects, hypertension, gastrointestinal problems, and vision disorders {Centers for Disease Control and Prevention, 2005-2010}. Down syndrome most widely recognized reason for gentle to direct educated incapacity, the condition occasionally is severe. People with Down syndrome are also much more likely to die from infections if left untreated {Cioni et al., 2011}. The incidence of Down syndrome is the most widely recognized reason for gentle to direct intelligent inability, the condition occasionally is severe.

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Children with Down syndrome are 10 to 15 times more probable than other kids to advance leukemia. The National Cancer Institute is investigating various types of leukemia that affect children with Down syndrome (Cohen, 2012). Physical exercises and games are critical for children with Down syndrome since strong muscles and good coordination protects the joints. Children with Down syndrome receiving prophylaxis can participate in most sports activities with their peers provided better improvement in their growth function ability .Since joint and muscle instability events are rare in patients receiving active exercise and are often associated with trauma (Lane et al., 2015). Maintaining balance requires inputs from visual, somatosensory, and vestibular inputs as well as their integration to reference the self within the environment. Different sensory inputs provide the central nervous system with different frames of reference about an individual's position of center of gravity relative to its base of support. Neither a single sense nor a combination of the three senses provides accurate or enough information for balance control purpose under all sensory conditions. Hence, the central nervous system needs to compare and integrate all the incoming inputs on the way to keep stability (Martin, 2009). An infant makes sense of how to be stable through practice and repetition as impulses sent from the sensory receptors to the brain stem and then out to the muscles form a new pathway.

With repetition, it winds up noticeably simpler for these driving forces to movement along that nerve pathway —a process called facilitation—and the baby can keep stability during any activity. Solid proof exists suggesting that such synaptic reorganization happens all through a person's lifetime of adjusting to changing movement environs. This pathway facilitation is the cause ballerinas and sportspersons practice so arduously. Even very complex movements turn out to be almost programmed over some undefined time frame (Palisano et al., 2012). Gait training states helping a patient relearn to walk securely and proficiently. Gait training is generally done by rehabilitation specialists who assess the deviations in the individual's gait and utilize such treatments as strengthening and balance training to improve stability and body perception as these relate to the patient's environment. The looked-for final outcome is for the patient to be able to walk securely in all environments with the minimal amount of assistive technology conceivable with the true objective of picking up a level of independence they did not before have (Parker, 2013).

Gait training alludes to helping a patient relearn to walk securely and proficiently.. The desired end result is for the patient to have the ability to ambulate safely in all environments with the least amount of assistive technology possible with the end goal of gaining a level of independence they did not previously have (Parker et al., 1986). The most critical distinction amongst ambulation and gait training is that gait training requires aptitude on the clinician's part to improve the gait pattern. It is important to be able to identify the difference so that we can document and bill for our services appropriately. Gait training begins with evaluating the abnormalities (or deviations) of a patient's gait and then tending them to mature a more "normal" walk pattern. Gait training incorporates something beyond just educating a patient how to use an assistive device. Teaching a patient how to use an assistive device is just one part of gait training and that is what we will review today (Rast et al., 2013). Treadmill ambulation training is a recent therapeutic approach that minimizes the delay during which gait training can be initiated with neurological patients. The patients are provided needed to initiate walking early in the rehabilitation process (Selby-Silverstein et al., 2012). Treadmill is an effective training device for practicing functionally improved gait pattern. Speed and distance of walking can be adapted to the patient's requirements. However, practicing on the treadmill can only be expected to lead to functional gains in patients with lower extremity dysfunction if it approximates the requirements of functional ambulation (Ulrich et al., 2012). Previously researches have shown that: stepping on treadmill and walking have many characteristics in common. Treadmill intervention offered repeated opportunities to improve balance and build muscle strength in the lower limbs and stimulate neuronal connections that are involved in generation of independent balanced walking. Developmentally, it has been suggested that sufficient strength and balance are two critical requests for the onset of independent balanced walking (Ulrich et al., 2014). Treadmill training was used for children with disabilities to help them to improve balance and build strength of their lower limbs so they could walk earlier and more efficiently than those children who did not receive treadmill training. Some studies showed that treadmill training helped these children to walk about 101 days earlier than children who did not train by treadmill (Ulrich et al., 2014). Multiple studies have compared treadmill to overground walking and they found that greater hip range of motion, greater maximal hip flexion angle and higher cadence during treadmill walking. They also observed a slightly decreased stance time compared to over ground walking. Similar findings of a higher cadence during treadmill walking were also reported. However, they found no significant differences in maximum ankle dorsiflexion or plantarflexion motion, moments or power (Ulrich et al., 2015). Certain characteristics of treadmill training are probably beneficial to the training of gait by externally forcing a rhythmical and dynamic gait pattern. With treadmill training, there is a relatively strong stretch applied to the hip flexors of the ankle at the end of the stance so enhancing muscular activity needed for swing phase. It was suggested that treadmill training is likely to be maximally effected when combined with functional lower limb strength training and practice of overground walking (Ulrich et al., 2015).

METHODOLOGY

The study was conducted in the out-patient clinic of the Faculty of Physical Therapy and Abu El-Rish hospital, Cairo University. Thirty Down syndrome children with age ranged from 7 to 11 years participated in this study and assigned into two groups of equal number as control and study groups. *Balance Master System:* The total time required for evaluation of each child was average 20 minutes and the evaluation was conducted before and after three successive months of training program. Each child have evaluation sheet which included the variables were assessed pre and post treatment program. Before starting the assessment of children of both groups, the personal data of each child was entered from the relatives such as name (first and last name), date of birth, and height on new patient file and pressed on Save Patient File and Continue buttons to start assessment. After complete the patient file, the assessment was starting through choosing each test from assessment menu. Each child of two groups was demonstrated about his position, how to start and perform the test as a preparation of child before starting each test. The assessment of the study and control children by using of Balance Master System was done through the following tests:

The WA test consists of three trials in each condition.

Position of the child: The child stood off the long forceplate at starting end according to the instructions appearing at the top of the screen. The test started by clicking on the WA button on the assessment menu. Each child was instructed to "HOLD" "STEADY" away of the force plate until the "GO" appears at the top of the screen

The WA test measured the following parameters

Step Width: Is the lateral distance in centimeters between the left and right feet on successive steps.

Step Length: Is the longitudinal distance in centimeters between successive heel strikes on successive steps.

Speed: Is the velocity in centimeters per second of the forward progression.

Step/Quick Turn: The SQT test consists of three towards each side: left first and right foot first.

Position of the child: the child's feet where placed on the long force plate according to the instructions appearing at the top of the screen.

Starting the test: The test started by clicking on the SQT button on the assessment menu. Each child was instructed to stand upright and as steadily as possible at each child was instructed to start with left foot take two steps forward turn around quickly to left and return to the end of the force plate. The same trial was applied for the right foot.

Tandem Walk (TW): It quantifies characteristics of gait as the patient walked with one heel of the foot placed in front of and touching to the toes of the other foot at sme line from one end of the force plate to the other. -Position of the child: the child's feet where placed on the long forceplate which one heel of the foot placed in front of and touched the toes of the other foot at the same line according to the instructions appearing at the top of the screen.

Starting the test: The test started by clicking on the TW button on the assessment menu. Each child was instructed to stand upright which one heel of the foot placed in front of and touched the toes

The TW test measured the following parameters:

Step Width: Is the lateral distance in centimeters between the left and right feet on successive steps.

Speed: is the velocity in centimeters per second of the forward progression.

End Sway: Is the velocity in degrees per second of the anterior/ posterior component of COG sway for 5 seconds beginning when the patient terminates walking.

For Treatment: ***Control Group:*** The treatment session would be conducted 60 minutes, three times per week for a period of three successive months. Children of this group received the following physical therapy program:

- Exercises to facilitate balance:
- the child walked forward and side way by using stepper as shown in, he walked across obstacles such as rolls of different sizes, blocks of different diameters and wedges of different heights.

Strengthening exercises: Isometric Exercise is typically preformed only for a few seconds that involves static contraction of muscles. That is, in this exercise, the muscle length remains the same even if it is been tensed by pressing against a static body such as a wall, building or an opposing pair of muscles. In fact, this is the procedure press the relevant muscle with force against any unmoving object for few seconds and repeats the procedure 10 to 15 times. The biggest plus with this type of exercise is that one can do it without the aid of any equipment and can do it as the whole procedure does not include even a single complex step. It is just about pushing against an immovable object or holding a weight for some duration. The following instruction should be considered while performing isometric Exercise

- Isometric exercise is not advisable for people with high blood pressure or heart ailments for isometric workouts pumps up the blood pressure and metabolic rates. Hence, people with such troubles are strongly advised against trying isometric exercises without getting clearance from their physicians.
- Isometric exercise done in one position increases the strength of the corresponding joint angle only. Hence for strengthening other joint positions as well, one needs to repeat the procedure in the respective angles or positions.

Advantages of Isometric Exercise

- Aids in building muscle strength mean while burning excess fat.
- Slows muscle erosion and enhances the tone and shape of muscles.
- Helps to improve bone density.
- Long sessions of isometric exercise are found to improve digestion and lower cholesterol levels.
- Bicycle ergometer training includes the following:
- Firstly, any restricted clothes were removed to facilitate the performance of exercise.
- The child was asked to sit on the seat of the bicycle with straight and supported back.
- Fixation of both feet by pedal straps was performed.
- The child was asked to grasp handles of the bicycle by both hands firmly to provide stability during training.
- Climb steady program, in which resistance has been increased gradually according to muscular force, was selected as this program was the most suitable one for the present disorder of those children.
- Each child was asked to perform pedaling on a bicycle ergometer starting with unloaded cycling for three minutes as a warming up. Then, the child perform pedaling while gradually increasing resistance for about 14 minutes and end the treatment session

For re-education of the movement: the main goal of re-education and facilitation treatment program is to enhance the motor control of the patient. This goal can be demonstrated by increased muscle force and increase voluntary range of motion, which leads to increase functional use of the extremity or joint.

Study Group: The treatment session would be conducted one hour, three times per week for a period of three successive months. Each time, the children of this group received thirty five minutes of the same physical therapy program as the children of control group and twenty five minutes of gait training by using treadmill. The procedure and goals of exercise were explained to the child before starting walking on treadmill. Any restricted clothes were removed to allow walking without difficulty. The child was asked to firmly grasp the parallel bars of the treadmill by both hands, he was instructed to look forward and don't look downward on his feet during walking as this may cause falling. Each child participated in these study was instructed to walk on treadmill with upright position at a speed of 1.5 Kilometers/hour and 0 degree of inclination for 5 minutes as a warming up. Then, the speed was increased gradually to reach 3 Kilometers/hour and 10 degrees of inclination for 15 minutes. The speed was returned to1.5 Kilometers/hour and 0 degree of inclination for another 5 minutes as a cooling down. Finally, walking was stopped immediately when the child felt pain, fainting or shortness of breath. Each child is instuected to wear supramalleolar orthosis during treadmill training

Statistical Analyses: Wilcoxon signed ranktest and Mann Whitney U test was used to analyze the pre and post treatment values of MAS scores and MACS scores within the groups and between the groups respectively. The level of significance was set at p<0.001. Data were analyzed using SPSS 17.0.

RESULTS

The results of pre and post treatment values were compared with each group .The results revealed significant improvement in both groups.

Balance Master system

Step width: As revealed from table (1) and Fig. (1) was observed in mean values of step width measured in both groups at the end of treatment as compared with the responding mean values before treatment (P<0.01).

Step Length (cm): As revealed from table (2) and Fig. (2) was observed in mean values of step length measured in both groups at the end of treatment as compared with the responding mean values before treatment (P<0.01).

Speed (cm/sec.): As revealed from table (3) and fig. (3) was observed in mean values of speed measured in both groups at the end of treatment as compared with the responding mean values before treatment (P<0.01).

Table 1. Pre and post treatment mean values of step width in both groups

Two Groups / Test	Mean± SD	MD	% of Diff	t-value	P-value
Pre (control)	22.327±1.066	0.027	0.12	0.25	0.808*
Pre (study)	22.3±1.145				
Post (control)	21.507±1.174	1.414	6.57	3.18	0.004**
Post (study)	20.093±1.261				

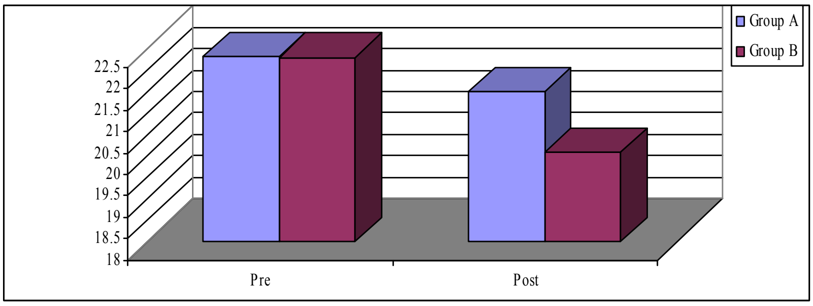

Fig. 1. Pre and post treatment mean values of step width in both groups

Two Groups / Test	Mean± SD	MD	% of Diff	t-value	P-value
Pre (Control)	31.693±1.627	0.14	0.44	0.25	0.808*
Pre (Study)	31.833±1.497				
Post (Control)	32.353±1.455	1.927	5.95	3.77	0.001**
Post (Study)	34.28±1.338				

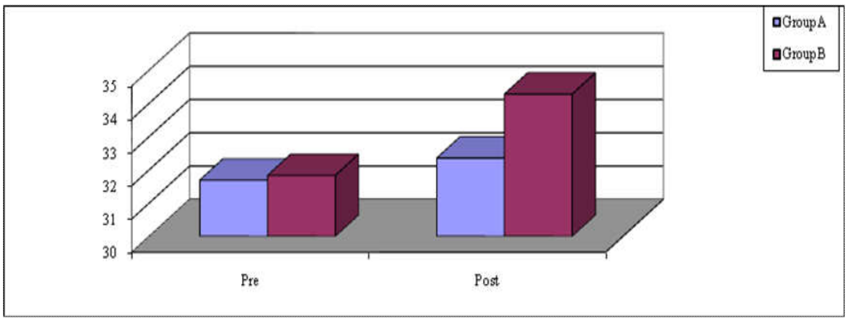

Fig. 2. Pre and post treatment mean values of Step Length (cm) in both groups.

Table 3. Pre and post treatment mean values of speed (cm/sec.) in both groups

Two Groups / Test	Mean±SD	MD	% of Diff	t-value	P-value
Pre (Control)	75.067±2.717	1.65	2.19	1.53	0.138*
Pre (Study)	73.414±3.201				
Post (Control)	76.267±2.473	2.72	3.56	2.89	0.007**
Post (Study)	78.987±2.473				

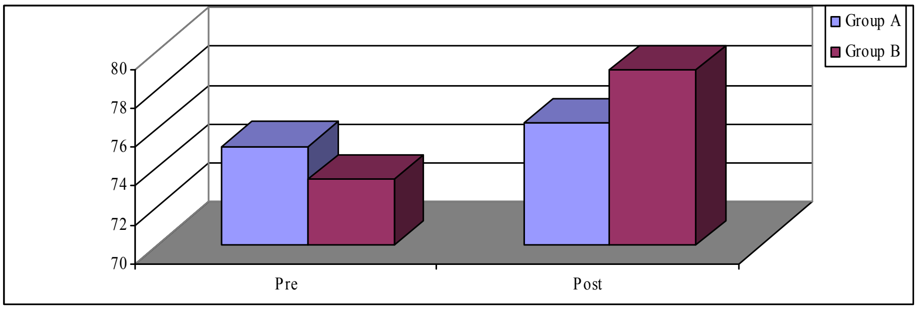

Fig. 3. Pre and post treatment mean values of speed (cm/sec.) in both groups

Table 4. Pre and post treatment mean values of Peabody (locomotion subtest) in both groups

Two Groups / Test	Mean±SD	MD	% of Diff	t-value	P-value
Pre (Control)	22.5±1.05	1.65	2.19	1.53	0.138*
Pre (Study)	22.44±1.01				
Post (Control)	29.267±1.473	2.72	3.56	2.89	0.007**
Post (Study)	33.587±2.473				

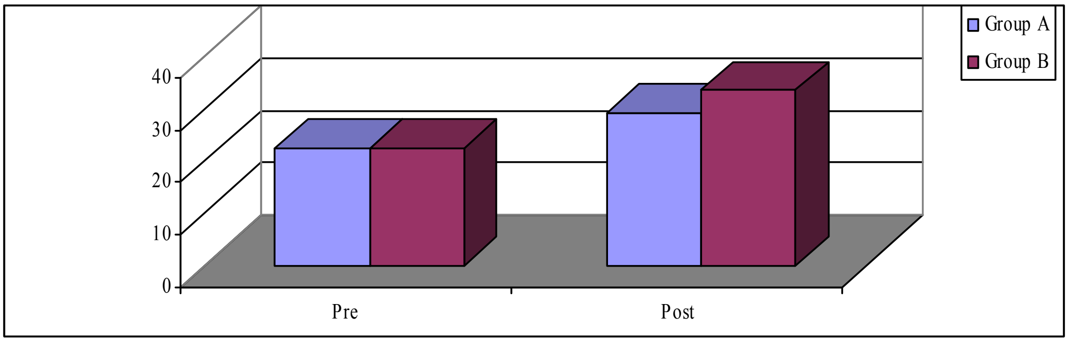

Fig. 4. Pre and post treatment mean values of Peabody (locomotion subtest) in both groups.

Peabody (locomotion subtest): As revealed from table (4) and Fig. (4) was observed in mean values of locomotive motor system Peabody developmental motor scale II measured in both groups at the end of treatment as compared with the responding mean values before treatment (P>0.01).

DISCUSSION

The purpose of this study was to determine whether the addition of SMOs to a treadmill training protocol for children with Down syndrome would lead to improved developmental outcomes. The hypothesis was that the addition of SMOs would lead to improved developmental test scores and balance abilities for Down syndrome children. In studies by Ulrich and colleagues (Ulricl et al., 2012), traditional treadmill training led to a large decrease in time to independent walking onset and to improved gait at walking onset compared with no treadmill training. In the current study, children with Down syndrome who received treadmill training as well as early orthotic use indicates that there may have been a moderate treatment effect in favor of the group that received SMOs. This finding suggests that the SMOs may positively affect the rate of walking development; however, although the major difference between this study and control on children with Down syndrome is the addition of orthosis, another large difference in this study is the time at which treadmill training was initiated. Previous studies began the treadmill training protocol when children could sit independently (Cohen, 2012). or take 6 to 10 supported steps on the treadmill (Ulrich et al., 2014). Because the current study focused on SMO use, the intervention did not begin until the children were able to pull themselves to a standing position and bear weight on their feet. This method correspond Down syndrome to that of Ulrich et al. (2015) who found that children with Down syndrome began to prefer alternating stepping patterns on the treadmill when they could pull themselves to a standing position and make forward progress in a prone position. On average, the children in this study pulled themselves to a standing position at 20.5 months, or about 2 weeks after the children who received treadmill training in the original study began to walk. Perhaps a better experimental combination of treadmill training and orthosis would include treadmill training, beginning at 10 months of age, and use of SMOs when the children can pull themselves to a standing position independently. This combination would allow the children to derive the maximal benefits from the treadmill training while still introducing the orthosis at a developmentally appropriate point. The effect of orthosis on PDMS-2 score is complex. As expected, all children in the study showed improvement in their gross motor skills during the course of the intervention. In addition, there was no group difference over the course of the intervention in the overall (PDMS-2 score. This finding was expected because all of the children entered the study at the same gross motor level (ie, ability to pull themselves to a standing position) and ended the intervention at the same gross motor level (ie, ability to take 3 independent steps without support). The use of orthosis while learning these skills may have limited the available solutions to solving the problem by limiting the amount of movement at the foot and ankle. In turn, the initial rate of increase in the standing scale scores was not as large in the experimental group as it was in the control group. During the development of a skill, children experiment with and explore multiple solutions to solving movement tasks. Through this process, they learn how to perform a skill and how to adapt that skill to new or differing circumstances. Perhaps the SMOs externally impose limits in ankle and foot alignment and range of motion during this important developmental period that detract from the variability of practice and thus the adaptability of the learned skills. Although the children in the experimental group were limited by the SMOs during the development of walking, the children in the control group had the opportunity to engage in this process of exploration before they received the orthosis. They were able to use the skills that they developed during the attainment of walking in addition to the stability gained from the SMOs to improve their gross motor skills.

Conclusion

Use of SMOs appears to have a detrimental effect on overall motor skill development in Down syndrome children and new walkers who have learned to walk while wearing the orthoses. Based on this information, health care professionals may want to postpone the use of SMOs in children with Down syndrome until they have learned to walk independently.

REFERENCES

Angulo-Barroso, R., Burghardt, A.R., Lloyd, M. and Ulrich, D.A. 2014. Physical activity in children with Down syndrome receiving a treadmill intervention. *Infant. Behav. Dev*., 31: 255-269.

Centers for Disease Control and Prevention. 2006. Improved national prevalence estimates for 18 selected major birth defects—United States, 2005–2010. MMWR; 54: 1301-1305.

Cioni, M., Cocilovo, A. and Rossi, F. 2011. Analysis of ankle kinetics during walking in individuals with Down syndrome. *Am. J. Ment. Retard*., 106: 470-478.

Cohen, J. 2012. Statistical Power treadmill training. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum.

Folio, D.J., Fewell, P.L., Avery, L.M. and Lane, M. 2000. Peabody developmental motor scale (PDMS-2-66 and PDMS-2-88) User's Manual. Cambridge, MA: Mac Keith Press.

Lane, D., Stratford, B. and Henderson, S.E. 2015. Motor skill development. In: Lane D, Stratford Down syndrome. Current Approaches to Down's Syndrome. London, United Kingdom: Holt, Rinehart & Winston; 187-218.

Looper, J., Wu, J. and Angulo Barroso, R. 2006. Changes in step variability of new walkers with typical development and with Down syndrome e. *J. Mo.t Behav*., 38: 367-372.

Martin, K. 2009. Effects of supramalleolar orthosis on postural stability in children with Down syndrome. *Dev. Med. Child. Neurol*., 46: 406-411.

Palisano, R.J., Walter, S.D. and Russell, D.J. 2012. Gross motor function of children with Down syndrome: creation of motor growth curves. *Arch. Phys. Med. Rehabil*., 82: 494-500.

Parker, A.W. and Bronks, R. Gait of Children with Down syndrome e. Arch Phys Med Rehabil; 61: 345-351, 2013.

Parker, A.W., Bronks, R. and Snyder, C.W. Jr. 1986. Walking patterns in Down's syndrome. *J. Ment. Defic. Res*., 30: 317-330.

Rast, M.M. and Harris, S.R. 2013. Motor control in children with Down syndrome. *Dev. Med. Child. Neurol*., 27: 682-685.

Selby-Silverstein, L., Hillstrom, H.J. and Palisano, R. 2012. The effect of foot orthoses on standing foot posture and gait of young children with Down syndrome. *Neuro Rehabilitation*., 16: 183-193.

Ulrich, B.D. and Ulrich, D.A. 2012. Spontaneous leg movements of children with Down syndrome e and nondisabled children. *Child Dev.,* 66: 1844-1855.

Ulrich, B.D., Haehl, V. and Buzzi, U.H. 2014. Modeling dynamic resource utilization in populations with unique constraints: preadolescents with and without Down syndrome. *Hum. Mov. Sci.,* 23: 133-156.

Ulrich, B.D., Ulrich, D.A. and Collier, D.H. 2015. Alternating stepping patterns: hidden abilities of 11-month-old children with Down syndrome. *Dev. Med. Child. Neurol*., 34:233-239.

Ulrich, B.D., Ulrich, D.A., Collier, D.H. and Cole, E.L. 2005. Developmental shifts in the ability of children with Hemophaliae to produce treadmill steps. *Phys. Ther*., 75:14-23.

Ulrich, D.A., Lloyd, M.C. and Tiernan, C.W. 2014. Effects of intensity of treadmill training on developmental outcomes and stepping in children with Down syndrome e: a randomized trial. *Phys., Ther*., 88: 114-122.

Ulrich, D.A., Ulrich, B.D., Angulo-Kinzler, R.M. and Yun, J. 2010. Treadmill training of children with Hemophaliae: evidence-based developmental outcomes. Pediatrics; 108: E84.

Ulricl, D.J., Palisano, R. and Walter, S. 2012. Evaluating motor function in children with Hemophaliae: validity of the GMFM. *Dev. Med. Child. Neurol*., 40: 693-701.

Wu, J., Looper, J. and Ulrich, B.D. 2010. Exploring effects of different treadmill interventions on walking onset and gait patterns in children with Down syndrome. *Dev. Med. Child. Neurol*., 49: 839-945.

Wu, J., Ulrich, D.A. and Looper, J. 2014. Strategy adoption and locomotors adjustment in obstacle clearance of newly walking toddlers with Down syndrome after different treadmill interventions. *Exp. Brain. Res*., 186: 261-272.

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