

The Benefits of Exercise for Children with Down Syndrome

By Adela Castaneda and Graduate Student Mentor, Jeremy Ducharme

Physical exercise is a versatile activity that can be practiced by a variety of people with distinct abilities, capacities, and goals. Participating in physical activities has repeatedly been shown to reduce the risk for certain diseases/disorders. Along with the general benefits of physical activity also comes specific benefits for certain groups of people. A particular population that is able to obtain additional benefits from participating in physical activity are children with cognitive and developmental disabilities. Such as those with Autism, intellectual disabilities and Down syndrome (DS). Notably, DS is a genetic disorder that affects about 1 in every 700 live births and can also provoke further health complications (7). Specifically, there are three types of DS, Trisomy 21, Translocation DS and Mosaic DS (5). It has also been well reported that youth with DS are characterized by delays in gross or fundamental motor skills (2). With the absence of such skills, there can also be a delay in the attainment of further skills, such as developing upper and lower body strength, proper balance/posture and other skills that are essential for performing activities of daily living (ADL). While there are a variety of physical activities that require specialized skills, there are other activities that can further develop such required skills. Continuing with the versatility of exercise, participating in physical activities can also serve as a form of physical and occupational therapy. For children with DS, participating in physical activities can help develop gross motor skills, improve balance, and improve upper and lower body strength (1). Exercise is an effective tool that can help children with DS improve health markers, improve motor skills, and positively affect their emotional state (4). Therefore, the purpose of this paper is to review research and determine the physical, mental and cognitive benefits of exercise on children with DS. A secondary aim of this review will be to examine how implementing such exercise skills as a child can positively impact individuals with DS as they progress into adulthood.

Effects on balance and postural stability

The continuous participation in physical activities can elicit gross and acute effects in the human body. Among those effects include improvements in balance and postural stability. Improving these aspects can in turn transition to better performing ADL. In children with DS, balance problems can result in difficulties performing everyday activities like walking downstairs or moving in a dark environment (1). A study conducted by Aly and Abonour aimed

to investigate the effects of core stability exercises on postural stability in children with DS. For eight weeks, children with DS received either a conventional physical therapy program (control group) or an addition of core stability exercises (study group). The core stability exercises consisted of Jeffrey's core stability exercises which focused on strengthening the abdominal, low-back, and pelvic muscles. Results displayed that both groups exhibited improvements in postural stability when comparing pre to post treatment measurements (1). They also found that the study group showed a significant decrease in anteroposterior, mediolateral, and overall stability indices, as a significant effect of core stability exercises on postural stability was observed (1). It was also speculated that the observed results may be attributed to how core stability training improves neuromuscular system performance, appropriate muscular balance, and good function (1). The study conducted by these authors is an evident example of how a specific type of exercise can be incorporated into a physical therapy session. With the incorporation of core stability exercises, children with DS can attain these skills at a young age and enter a progressive training pathway that prepares them to later on display mature and sophisticated movements at an older age (1). In addition to its effects on postural stability, incorporating specific exercise programs can also improve balance markers.

A review article by Maïano and colleagues intended to demonstrate what effects, if any, do exercise programs have on improving balance in children and adolescents with DS (2). All the studies included demonstrated that the exercise program groups displayed significantly higher posttest static, dynamic and static-dynamic balance values than the control groups (2). Additionally, the reviewed studies found that in contrast to control groups, exercise programs with a duration of 6 to 24 weeks significantly improved static balance and static-dynamic balance of children with DS (2). Despite the positive results from these studies, the authors advise caution when drawing conclusions from this review, as only a limited number of studies were reviewed and only few studies considered the effects of exercise programs on balance in adolescents with DS (2). The implementation of a specific exercise program has been shown effective to improve markers of balance and postural stability in children with DS. Implementing such exercise regimes at a young age can increase adherence and maximize results when children with DS progress into adulthood.

Dance as an exercise program and form of therapy

When children with DS develop proper balance and postural stability, higher skill activities, such as dance, can be performed. This activity not only serves as a form of exercise but also puts in practice previously attained skills that have been learned either during a therapy session or an exercise program. A study conducted by Parab and colleagues aimed to investigate the effects of a 12-week Bharatnatyam (Indian classical dance form) based dance therapy protocol on children and adolescents with DS (3). Thirty children with DS, ages 5 to 18, participated in the study. The dance protocol consisted of 60 minutes, conducted three times a week for 12 weeks. Participants were then evaluated for outcomes on body mass Index (BMI), body composition, lower limb isometric strength and power, cardiorespiratory fitness, reaction time and dynamic/functional balance before and after the intervention. They found that the implementation of a Bharatnatyam based dance therapy exhibited a 34-86% improvement on outcomes of strength, 18-39% improvement on balance outcomes, 27-59% gains in cardiorespiratory fitness and 2-18% change in body composition parameters (3). The authors also confirmed that Indian classical dance training can systematically enhance alignment, flexibility, core strength and selective motor control when incorporated into rehabilitation for children with DS (3). Despite the results from this study, certain limitations should be taken into consideration. The participants in this study were healthy and motivated. Therefore, it needs to be further investigated if the results can be generalized to all children with DS (3).

A pilot study conducted by McGuire et al., measured the effects of an adapted dance program (*Ballet Moves*) on motor abilities and participation in children with DS (4). The intervention consisted of one hour adapted dance sessions for a total of 20 weeks. Outcome measures included The Canadian Occupational Performance Measure and the Gross Motor Function Measure dimensions D (standing) and E (walking, running and jumping). Results found significant improvements in the Gross Motor Function Measure as well as physical, cognitive, and emotional improvements as reported by caregivers (4). The authors of this study concur with the hypothesis that an adapted dance program meeting once a week for 20 weeks, improves gross motor abilities in children with DS (4). According to the results obtained in both studies, implementing a dance program can elicit improvements in gross motor skills, as well as physical and emotional improvements for children with DS.

High intensity physical conditioning programs

When children with DS can participate in a variety of physical activities, higher intensity exercises can be implemented. A study conducted by Ortiz-Ortiz and colleagues aimed to determine the effects of an exercise program on body composition and isometric strength in children with DS (5). Twenty-two children were divided into an experimental group or a control group. Some measurements included isometric handgrip strength, triceps and medial calf skinfolds and BMI. Results showed significant reductions in medial calf skinfolds and isometric strength in the experimental group (5). They found that their exercise program improved isometric strength and body composition markers in children with DS (5). The authors suggest that implementing a structured exercise program can improve quality of life in children with DS (5). If quality of life is improved, then children with DS can continue partaking in such programs with the goal of continuing to observe improvements in strength and markers of body composition. When designing a specific training program for children with DS, the physical capabilities, limitations and capacities of these children need to be taken into great consideration. When children with DS develop more skilled motor skills, coordination/balance skills and overall strength, higher intensity exercises can now be implemented. High-intensity interval training (HIIT) is a specific exercise that incorporates all the aforementioned factors. A review article by Ware and colleagues investigated the benefits of incorporating HIIT programs for individuals with DS (6). They found that incorporating HIIT as part of an exercise program for individuals with DS could be beneficial for improving critical health outcomes in a time-efficient manner (6). The authors also mentioned that the potential attention deficit experience might make HIIT more effective and enjoyable (6). Overall, incorporating HIIT programs produces positive outcomes in adults and children with DS. Therefore, incorporating HIIT programs into the lifestyle of children with DS can help improve several body composition markers, improve isometric strength, and improve quality of life.

Aquatic exercises and functional fitness

Progressing to the observed effects of exercise in adults with DS, aquatic exercises are another form of physical activity that can improve several health markers and carry on those effects into adulthood. Past studies conducted on adults with DS have shown improvements in functional fitness (aerobic capacity, muscular strength, balance etc..) with different exercise modalities (7). A specific study conducted by Boer aimed to investigate the effects of freestyle

swim training on the functional fitness of adults with DS (7). Twenty-six individuals were divided into an exercise group or a control group. The exercise group performed 30-minute freestyle swim training sessions, three times a week, for eight weeks. Results showed significant differences between the two groups in terms of body mass, body composition, aerobic capacity, dynamic balance, 12-m swim time and 8-ft get-up-and-go functional ability (7). They found that several markers of functional fitness significantly improved after an intervention of freestyle swim training in adults with DS (7). With the improvement of such markers, adults with DS can experience a healthier life and reduce the risk for certain diseases.

Another study conducted by Boer and DeBeer also investigated the effects of an aquatic training program on the functional fitness for adults with DS (8). Participants were divided into an aquatic training group or a control group. Where the exercise group performed 35 minutes of aquatic training, three times a week, for six weeks, with an increase in duration of 45 minutes after week three. Some outcome measures included aerobic capacity, and functional ability and balance. Results showed that the exercise group exhibited significant improvements in aerobic capacity and functional ability (8). The authors did however mention that the aquatic intervention was insufficient to improve balance and upper body strength (8). It is also worth noting that such aquatic exercise programs should only be used for individuals that feel safe in the water or have assistance.

Effects of aerobic and strength exercise programs

In addition to aquatic exercises, other aerobic as well as resistance exercises are also specific exercise programs that can elicit effects in adolescents and adults with DS. A study conducted by Ptomey and colleagues aimed to investigate changes in cognitive function after 12 weeks of an exercise program in adults with DS (9). Twenty-seven participants attended 30-minute group exercise sessions 1 or 2 times a week. Exercise sessions were delivered via video conferencing and consisted of aerobic based exercises (such as walking and jogging to music) and strength-based exercises (including vertical jumps, bicep curls and squats). Cognitive function was measured to assess the cognitive domains of memory, attention and reaction time. It was found that cognitive function improved after this 12-week intervention (9). An improvement in cognitive function can translate to helping children with DS retain their attention during a specific exercise, memorize certain exercise protocols or have a faster reaction time during a specific task. It was also mentioned that some limitations to this study include a small sample

size and the inclusion of mostly white adults with DS. To generalize the benefits of such an aerobic/strength training program, more research needs to be done in a variety of adults with DS.

Another study conducted by Seron and colleagues aimed to investigate the effects of a 12-week aerobic and resistance exercise program on body composition of adolescents with DS (10). Participants were divided into an aerobic training group, a resisted training group and a control group. Measurements included fat evaluation, waist circumference and body weight. Results showed that the aerobic training group exhibited significant improvements in body composition. (10). However, the control group increased fat percentage, while the resistance training group, maintained body fat levels (10). In conjunction, these findings indicate that aerobic exercise programs and resistance training are effective exercise programs that can be used for adults and adolescents with DS.

Conclusion

The many benefits that different types of exercise bring for children with DS persist throughout childhood and into adulthood. Whether the exercise includes an aerobic, strength, balance, or postural stability component; participating in physical activity allows children with DS to improve functional fitness, a variety of balance markers, cognitive abilities, motor skills and body composition markers. Implementing an exercise program in early childhood years, will allow individuals with DS to become proficient in certain skills required for performing more complex movements as well as higher intensity exercises. As with the design of any exercise program, individualization is what promotes the most benefits, as for children with DS; programs should focus on what the child can do, can improve on and can ultimately master.

ApplyIt!

- Health and fitness professionals will be able to incorporate different types of exercise modalities into exercise programs for children with DS.
- Health and fitness professionals will be able to design exercise programs that can be implemented from childhood into adulthood for children with DS.
- Health and fitness professionals will be able to learn how specific types of exercises can improve skills that are necessary for performing ADL.

Bridging the Gap

Participating in physical activity can elicit many benefits. Children with DS can especially benefit from partaking in physical activities, as the skills learned through exercise can

carry on to other activities that children with DS conduct. Different types of exercises have been shown to improve cognitive abilities, balance, and a variety of health markers in children with DS. Therefore, implementing an exercise program during childhood can maximize the benefits brought by physical activity throughout adulthood.

Summary Statement

An individualized exercise program for children with DS should be tailored to their needs, abilities, and areas of improvement. The benefits seen will not only pertain to the child's health but also aid in improving other activities that the child usually participates in.

Pulled text

“Participating in physical activity allows children with DS to improve functional fitness, a variety of balance markers, cognitive abilities, motor skills and body composition markers. Implementing an exercise program in early childhood years, will allow individuals with DS to become proficient in certain skills required for performing higher intensity exercises.”

Bio

Adela C. Castaneda, B.S., is currently pursuing her undergraduate degree in Exercise Science at the University of New Mexico and after graduating, plans on attending graduate school to obtain her master's degree in occupational therapy. Her interests are exercise interventions and program design for special needs populations.

References

1. Aly SH, Abonour AA. Effect of core stability exercise on postural stability in children with Down syndrome. *IJMRHS*. 2016;5(10):213-22.
2. Mañano C, Hue O, Lepage G, Morin A, Tracey D, Moullec G. Do Exercise Interventions Improve Balance for Children and Adolescents With Down Syndrome? A Systematic Review. *Phys Ther*. 2019;99(5):507-18.
3. Parab S, Bose M, Shayer S, Saini RK, Salvi M, Ravi P, Sawant P. Effect of Bharatnatyam-based Dance Therapy in Children and Adolescents with Down Syndrome. *Clinical Kinesiology*. 2019;73(3):15-20.
4. McGuire M, Long J, Esbensen AJ, Bailes AF. Adapted Dance Improves Motor Abilities and Participation in Children With Down Syndrome: A Pilot Study. *Pediatr Phys Ther*. 2019;31(1):76-82.

5. Ortiz-Ortiz M, Terrazas-Ordorica KI, Cano-Rodríguez LE, Gómez-Miranda LM, Ozols-Rosales A, Moncada-Jiménez J. Effect of an intensive physical conditioning program on body composition and isometric strength in children with Down syndrome. *Journal of Physical Education and Sport*. 2019;19(3):897-902.
6. Ware ME, McCully KK, Feito Y. Benefits of incorporating HIIT programs for individuals with down syndrome. *ACSM's Health & Fitness Journal*. 2020;24(4):18-23.
7. Boer PH. The effect of 8 weeks of freestyle swim training on the functional fitness of adults with Down syndrome. *Journal of Intellectual Disability Research*. 2020;64(10):770-81.
8. Boer PH, DeBeer Z. The effect of aquatic exercises on the physical and functional fitness of adults with Down syndrome: A non-randomised controlled trial. *Journal of Intellectual Disability Research*. 2019;63(12):1453-63.
9. Ptomey LT, Szabo AN, Willis EA, Gorczyca AM, Greene JL, Danon JC, Donnelly JE. Changes in cognitive function after a 12-week exercise intervention in adults with Down syndrome. *Disability and Health Journal*. 2018;11(3):486-90.
10. Seron BB, Silva RA, Greguol M. Effects of two programs of exercise on body composition of adolescents with Down syndrome. *Rev Paul Pediatr*. 2014;32(1):92-8.