Exercise Programming for Children With Autism Spectrum Disorder: Recommendations for Strength and Conditioning Specialists

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ABSTRACT

The purpose of this article is to introduce strength and conditioning specialists to autism spectrum disorder (ASD) and to identify the many benefits of delivering exercise programs to children with ASD. In addition, the article aims to inform strength and conditioning specialists on how to minimize some of the inherent challenges associated with the delivery of such programs by highlighting critical issues for practitioners to consider when designing and implementing exercise programs for children with ASD.

INTRODUCTION

Autism spectrum disorder (ASD) is a complex neurological disorder with a globally estimated rate of 1 in every 160 children (11). The diagnostic criteria of ASD are divided into 2 domains. One domain focuses on deficits in communication and social interaction, which persist across multiple contexts. It consists of impairments in social-emotional exchange, nonverbal communication, and developing relationships with others. The second domain is related to repetitive patterns of behavior, such as motor movements (e.g., hand flapping and body rocking), insistence on sameness, and restricted interests (1). These characteristics are evident from a young age and impact all aspects of life, such as at home, in school, and in the community. The severity of ASD is determined by the level of support required (1). It is essential to note that ASD has a broad spectrum of symptoms, and no 2 individuals may necessarily exhibit the same range of ASD symptoms.

PHYSICAL ACTIVITY LEVELS OF CHILDREN WITH ASD

Low levels of physical activity present as a significant health concern for children with ASD. There is research reporting that children with ASD are significantly less physically active than children without ASD (29,52). A national survey in the United States compared physical activity levels between children with (n = 915) and without (n = 41,879) ASD and found that children with ASD are 60% less likely to participate in regular physical activity for more than 3 days a week (29). Inactivity among children with ASD may contribute to the higher prevalence of obesity that exists among this population. Previous research indicates that children with ASD are 72% more likely to be obese than children without ASD (29). Failure to accrue

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adequate amounts of physical activity, and the heightened risk for obesity among children with ASD, may predispose this population to many health risks. Such health risks include asthma, diabetes, high cholesterol, high blood pressure, mobility issues, and mental health conditions (43,44,57). Strength and conditioning specialists should be well versed in exercise prescription and coaching strategies, which places these specialists in a position to help limit or reverse the harmful health risks associated with inactivity. However, there are several factors to consider when designing and delivering exercise programs to children with ASD. These factors include the environment in which the program will be completed, how the strength and conditioning specialist will communicate and instruct the exercise, and the exercise interest of the child.

**BARRIERS TO EXERCISE AMONG CHILDREN WITH ASD**

Children with ASD face unique challenges that may limit their opportunities and abilities to participate in exercise. Children with ASD, parents, and teachers have reported on these barriers, citing interpersonal, intrapersonal, and environmental factors that impact exercise participation. Adolescents with ASD have stated the challenges that they experience when participating in exercise. These challenges are in relation to motor skills, social interaction, sensory processing, and environmental factors (2). Individuals with deficits in social interaction and communication have found participation in group-based exercise challenging (51). Adolescents with ASD have spoken of increased anxiety toward exercise participation because of complex social demands and incidents of bullying and isolation during the inclusive exercise program (2,20). Motor deficits have also been identified as significant barriers to exercise participation (20,36). Motor deficits are in relation to motor coordination, postural control, hypotonia, and difficulties with the planning of motor skills (15,32,41,46). These movement impairments may hinder the participation of children with ASD in exercise programs not adapted to their needs (17).

Environmental factors such as lighting, sound, and area size also need to be considered because they may negatively affect children with ASD participating in exercise. This is because there is a high prevalence of sensory processing abnormalities in children with ASD (9). Sensory processing is the ability to process sensory information and respond appropriately to sensory stimuli (28). Children with ASD may be hypersensitive or hyposensitive to certain sensory stimuli (28). Exercise environments may be highly sensory-stimulating, such as a sizeable crowded area of an exercise hall, and children with ASD have been reported to respond negatively to increased auditory, visual, and tactile stimuli of these settings (20,30). Hyposensitivity may be noted as an underresponsive-ness to an environment; these individuals may see, hear, and feel the area in a more muted way than others (12). Parents of children with ASD have also reported a lack of structured programs outside of schools that provide the support necessary to meet the needs of their child (37). Additional challenges that have also been noted include financial issues, time constraints, and transportation (34).

**BENEFITS OF EXERCISE FOR CHILDREN WITH ASD**

Despite the previously noted barriers, there is extensive literature to support the benefits of exercise for children with ASD. Improvements in stereotypical behavior, social interaction and communication, academic functioning, sensory processing, disruptive behavior, and mental health have all been reported (8,21,49). Exercise has also shown to improve physical fitness levels among children with ASD. Exercise interventions have led to improvements in body mass index, aerobic fitness, muscular strength and endurance, flexibility, balance, and motor skills (16,21,27,42,61). The benefits, as mentioned earlier, have been derived from a variety of exercise programs incorporating different training modalities including walking/jogging (39,42), horseback riding (7), swimming (40,61), martial arts (3,33), cycling (56), and yoga and dance (24,45). Previous research indicates that a range of exercise modes can have a beneficial effect on children with ASD. However, more research is required to establish the effects of traditional strength and conditioning programs, which are specifically tailored to suit the needs and abilities of this population.

**PRACTICAL CONSIDERATIONS FOR THE DELIVERY OF AN EXERCISE PROGRAM**

Because of the numerous benefits of exercise for children with ASD, combined with the high levels of inactivity and obesity reported among these children, it is crucial that this population is encouraged to participate in exercise. To effectively enable children with ASD to enjoy and engage in exercise, strength and conditioning specialists should consider several behavioral modification techniques when planning and delivering exercise programs for this population. These modification strategies aim to improve engagement, motivation, desired outcomes, and long-term adherence to an exercise program. Not all children with ASD will present with the same challenges toward exercise participation. Strength and conditioning specialists should evaluate each child’s specific needs before beginning an exercise program through observation, consultation with family members, and health care professionals who work closely with the child. Each of the following recommendations may not be suitable for all children, and the strength and conditioning specialist must decide which modification techniques are appropriate for each child.

**ENVIRONMENT**

The environment in which exercise programs take place is crucial for children with ASD. It is recommended that exercise programs are
implemented in consistent settings, as some individuals with ASD may struggle with change and disruption in their routine (31). Changing to unfamiliar environments may lead to an increase in anxiety for some children and reduce their participation. An adjustment period is recommended before exercise begins to allow children time to adjust to the unfamiliar setting and sensory stimuli (60). The equipment layout within the setting may also have a disruptive influence on the child with ASD, as it may be distracting and visually overwhelming. It is recommended to set up equipment when it is required for a particular task and cleared away before moving on to the subsequent task (50). Furthermore, a wide-open space may also be distracting for some children. The use of room dividers is recommended to limit the space, which may help promote attentiveness and engagement (31,47).

Research has reported that over 96% of children with ASD report hypersensitivity and hyposensitivity across numerous realms, which may lead children to be overresponsive or underresponsive to certain stimuli (22). It is recommended to investigate what level of sensory sensitivity the children may have before starting any exercise program to minimize these stimuli as much as possible (19). It has been observed that the environment in which exercise is completed may provide sensory challenges commonly reported by children with ASD (20). Examples of how to alter sensory stimuli for children that are hypersensitive to certain stimuli during exercise can be seen in Figure 1. For hyposensitive children, it is recommended to use weighted vests or sensory diets when children become underresponsive to improve their focus (48,54). A sensory diet is a combination of activities with sensory stimulation to meet the needs of the child, intending to keep the child calm and alert, preventing challenging behaviors allowing the child to feel in control, and improving their activities of daily living (25). From a strength and conditioning specialist point of view, some examples that could be included in a sensory diet of a child could be jumping on a trampoline, rolls on a yoga ball, or an isometric exercise hold, for example, the plank. Children may display challenging behavior when they become overstimulated and should be allowed to leave the exercise setting, accompanied by a teacher, to use a sensory room or quiet room to self-regulate. Once the child has self-regulated, they are encouraged to rejoin the exercise class.

There is debate as to whether group or individual exercise programs produce more benefits for children with ASD. Individual interventions may allow the strength and conditioning specialist to tailor the program to the individual’s specific needs and interests (47). Individual interventions may reduce stress and anxiety for children with ASD as they decrease social interaction demands, along with decreasing the unpredictability associated with many group activities. Participating in individual interventions may result in the child lacking the social interaction and communication benefits that have been associated with group exercise programs (3,33,40,62). Nonetheless, a meta-analysis comparing individual- and group-based exercise programs indicated that individual programs produced greater effects on social skills compared with group programs (49). Individual programs may not be available or practical. Group-based physical activity sessions may be the only programs offered. Specialized classes, consisting of only children with ASD, have been shown to be more beneficial for social functioning, improvements in muscular strength and endurance, and motor skill development, compared with classes that include children with and without ASD (21).

**COMMUNICATION AND INSTRUCTION**

Individuals with ASD may communicate using a variety of methods, including verbal and nonverbal forms of communication. In a recent study, including 165 children with ASD between the ages of 4–6 years, 15% were categorized as nonverbal, and an additional 10% were reported to be minimally verbal (35). Some children with ASD lack verbal communication skills but communicate effectively through visual aids (14). Using visual aids is a critical method of achieving effective communication during exercise.

**VISUAL SUPPORTS**

Visual supports are any visual presentations that may support an individual throughout their day (22). Visual supports may be the use of a picture or a video demonstrating the activity to be completed. In a strength and conditioning program for children with ASD, visual supports may be useful for communicating a specific type of exercise (6). Preferably, this visual support...
should portray a child of a similar age and sex (14). Research has demonstrated the value of incorporating visual supports into the delivery of exercise programs for children with ASD. Previous research successfully incorporated visual supports into a cycling intervention for children with ASD, where visual supports were used to assess self-efficacy and engage nonverbal participants in goal setting, self-monitoring, and self-reinforcement (56). The use of visual support of exercise movements may aid in the understanding of the required movements.

The use of pictures and videos is an effective means of communicating with children with ASD (10). Pictures may be used in the exercise class to show different stages of an activity. Pictures of the exercise(s) should be displayed as a reference throughout the exercise. In conjunction with pictures, The Story Creator application (Innovative Mobile Apps Ltd) may be used to show critical phases of each exercise, which the children can imitate (10). The Story Creator can include videos, pictures, and written text of the exercises. Within the storyboard for each exercise, the video can be embedded, along with audible and visual text, describing what is required of the child. Through this, learning is reinforced, and participation is increased while underpinning self-efficacy in the child’s ability to perform a task (56).

Instructions on how and when to use visual aids with exercises can be seen in Tables 2 and 3.

Activities for children with ASD should be planned and scheduled by the strength and conditioning specialist before the exercise session (60). Although there is a need for flexibility for the introduction of new exercises, children with ASD respond well to routine and structure (19). This routine can be reinforced through the use of a visual schedule or a visual “To Do” list. A visual schedule involves a series of pictures to depict a sequence of activities or events (23). When used as part of an exercise program, the visual schedule provides children with a clear structure of the class. Children may experience less anxiety if they can anticipate what exercise is coming next, therefore improving participation (19). When an exercise is performed, a child can move the exercise off the “To Do” list and place it on the “Done” list. This act may foster a sense of achievement, along with the physical activity, increasing the child’s self-efficacy and self-determination (56). This may improve motivation and engagement in physical activity. A written schedule may be sufficient for some children; however, using pictures with simple written instructions may be more suitable for others. It is vital to maintain consistency throughout the program and to keep the classes familiar to what the child knows.

This is completed by advancing existing exercises gradually. Although consistency in the classes is essential and should be reinforced through visual schedules, practitioners must make modifications to the exercise selection to progress or regress an exercise depending on the ability of the children.

**PHYSICAL PROMPTS AND TOKEN REWARDS**

Physical prompts have previously been used to aid in the completion of a task. Successful completion of a task may be achieved with the use of prompting, which are instructions to initiate a task (38). Yanardağ et al. suggested the use of a prompt before the instruction of the activity is given (e.g., “you get a sticker for good catching in this exercise”). The sticker is given after the performance of a successfully completed skill (60). While strength and conditioning specialists may provide more specific feedback linked to a technical cue, such as “Great looking forward and keeping your eyes on the ball when catching.” When working with children with ASD, the coach should provide basic feedback. Tokens may be used to promote good behavior. With the use of a token system, the child gains some control with a choice opportunity such as “if I listen to all instructions and try my best, I will get a token for my favorite toy” (60). This is based on techniques used in applied behavioral analysis,
which has been used to decrease inappropriate behavior and improve the teaching and maintaining of skills (53). A similar token system used to encourage children with ASD to participate in exercise was used in a recent study (62). This consisted of stickers that could later be traded for a gift or a favorite toy (62). Research has shown that prompts and tokens may increase behavioral outcomes for individuals with developmental disabilities (5,58).

VERBAL INSTRUCTION

It is recommended to use instructions that are concise and have minimal jargon (19). Verbal instructions should be phrased positively instead of negatively. Some children with ASD have been known to respond to the final words of a sentence, not taking the full meaning into account. For example, it is preferable to say, “Put the weight down slowly” as children may respond to the final word “slowly” rather than, “don’t drop the weight” where a child may focus on “drop.” Finally, it is recommended that the strength and conditioning specialist uses language that is as simple as possible (18). With many children with ASD, it is best to avoid overusing metaphors when coaching. This is recommended because of the tendency for some children with ASD to interpret language literally (59).

A welcoming verbal phrase or a gesture may enhance motor skill competence and execution with this initial connection (18,60). Positive verbal feedback should be used, such as “great catching” or “good jumping” to motivate the child and maintain engagement with the activity (4,60). Verbal communication should be clear and concise. For the exercise instructions, the language used should be the same as what is written on the picture or in The Story Creator application. Consistency is vital to enhance understanding, learning, and performance.

EXERCISE PROGRAMMING FOR CHILDREN WITH ASD: A PRACTICAL EXAMPLE

Although all training programs are context-specific and will be dependent on the nature of the children in the group, in addition to the time, facilities, and human resources available, the following section details a sample exercise program that can be implemented by practitioners. Before the beginning of any exercise program, it is recommended that practitioners ask the parents/guardians of the children to provide information on the likes and dislikes of their child as well as identifying any repetitive movements they engage in (Table 1).
## Table 2
Sample exercises at the commencement of an exercise program

| Phase of the session | Exercise          | AMSC targeted                                  | Instructions                                                                 |
|----------------------|-------------------|------------------------------------------------|------------------------------------------------------------------------------|
| Warm-up              | Traffic lights    | Acceleration, deceleration, and reacceleration | Green cone = run                                                            |
|                      |                   |                                                | Yellow cone = walk/slow motion                                               |
|                      |                   |                                                | Red cone = stop                                                             |
| Jumps and landing    |                   | Jumping, landing, and rebounding mechanisms    | Instruct children to perform a safe “motorbike” landing. Encourage landing with feet apart, knees bent, and arms forward like holding motorbike handles. |
| Main phase           | Reaction game     | Throwing, catching, and grasping               | Commands children must follow and identify, e.g., heads, shoulders, knees, and toes. As soon as the command “ball” is called, children must grasp the ball rapidly. |
|                      | Bean bag scramble | Throwing, catching, and grasping               | On “go,” children run to the center, grasp a bean bag, return to the start position, and throw the bean bag into their hula hoop. |
|                      |                   | Upper-body pulling                             | Children lie prone and move in an army crawl movement, pulling with their upper body to move forward. |
|                      |                   | Antirotation and core bracing                 | Move in a crab walking motion. This can be performed both forward and backward. Progress to the introduction of a ball moving with their feet. |
|                      |                   | Upper-body pushing                             | The aim is for the children to maintain the balloon in the air using any part of their body, e.g., head, hands, and feet. |
| Cool down            | Popcorn           | Upper-body pulling and pushing                | Place the bean bags on the parachute and instruct the children to lift the parachute up and down, to make the bean bags pop like popcorn. |
|                      |                   | Flexibility stretches: butterfly stretch, alternate leg toe touch (seated), knee hug, cobra stretch, toe touch (standing), and quad stretch. |
| Phase of the session | Exercise | Targeted                                      | Instructions                                                                 |
|----------------------|----------|-----------------------------------------------|-----------------------------------------------------------------------------|
| Warm-up              | Traffic lights | Acceleration, deceleration, and reacceleration | Green cone = run<br>Yellow cone = walk/slow motion<br>Red cone = stop<br>Blue cone = bunny hops<br>White cone = bear crawl |
|                      |          |                                               | Floor is lava<br>Lower-body unilateral, jumping, landing, and rebounding mechanics | With all hoops placed around in a circuit, children jump from hoop to hoop, not making contact with outside the hoop. |
| Main phase           | Reaction game (partners) | Throwing, catching, and grasping | One ball placed between partners. Following and pointing out commands (e.g., heads, shoulders, knees, and toes). When “ball” is called, both the children must reach to grasp the ball as fast as possible. |
|                      | Color targets | Throwing, catching, and grasping | Children have their own ball and run around the room bouncing, throwing, and catching the ball. Children are instructed to throw the ball at a colored target and catch the ball. |
|                      | Inch worm | Upper-body pulling | In pairs, one child lies prone on the ground and the other child stands about a foot from their partner’s head with their back to their partner. The child on the ground holds onto their partner’s ankles and pulls forward. Their partner moves forward, and the children repeat the movement pattern. |
|                      | Crab soccer | Antirotation and core bracing, upper body and lower body | Moving in a crab walking motion, forward, backward, and side to side. Two teams of 3 play soccer while remaining in the crab walk position. |
|                      | Volleyball | Upper-body pushing, acceleration, deceleration, and reacceleration, lower-body bilateral and unilateral | Two teams of 3 on either side of the room, divided by a centerline. Children must keep the balloon in the air similar to volleyball, scoring a point when the balloon touches the surface on the opposite side of the centerline. |
| Cool down            | Popcorn   | Upper-body pulling and pushing | Place bean bags on the parachute and instruct the children to the lift the parachute up and down to make the bean bags pop like popcorn. |
|                      | Stretches | Flexibility stretches: butterfly stretch, alternate leg toe touch (seated), knee hug, cobra stretch, toe touch (standing), and quad stretch. |
approach should assist the strength and conditioning specialist in developing an exercise program that is individualized to the unique ASD needs of the children within the group.

The warm-up period may be used as a time to prepare children for the exercise class. This time is essential for acquiring the attention of the children and maintaining their engagement with the exercise class. The warm-up may also act as an “icebreaker,” enabling the children to familiarize themselves with the strength and conditioning specialist and the exercise environment (55). The warm-up may consist of movements such as walking, running, and jumping sequences such as ladder hops (Figure 2). Games can also be included, such as tag, snatch the bacon (Figure 3), and “mirroring.” Mirroring is where children mimic each other in performing various movements (Tables 2 and 3).

The main phase of the exercise class may be used to introduce the athletic motor skill competencies to be introduced and performed. Skills and movement patterns may be performed and corrected in this main phase section. With the introduction of new exercises to children with ASD, structure is the key to participation and engagement. The familiarity of routine is accompanied by self-efficacy, which breeds a desire to complete the exercises and overall session (18). When exercises are completed and appropriate behaviors exhibited, these behaviors should be acknowledged through positive reinforcement (60). Progression of the main phase activities may occur in 3 stages: learning the components of the activity, compiling the components of the activity to complete a race, and being able to play a game with others in the activity class. An example of how exercises can be progressed is provided in Tables 2 and 3. Bean bag scramble is a throwing and catching activity introduced by throwing a beach ball a short distance back and forth to a partner. This can be progressed by changing the weight and size of the ball and increasing the throwing distance. A race can then be introduced to challenge the children to throw the ball back and forth several times without dropping the ball. Finally, the task can be progressed into “bean bag scramble,” where the intention of the game is to throw the bean bag at various targets for points (Figure 4).

The cool-down period is a time for reflection (26), which may be used to praise children for their excellent work in class and prepare them for the next class. The reduced tempo of the cool-down period and quiet stretching allows children to prepare to move from an activity class back into the classroom environment. The cool down may consist of static stretches that are held for 20–30 seconds. Stretches may include the butterfly stretch (seated groin stretch), seated alternate toe touch (elongation of hamstrings and reaching for toes), cobra stretch (refer to Figure 5), lying knee hug (hip and lower back stretch), and quad stretch (standing quadriceps stretch and improving balance) (13).

**CONCLUSION**
There is no “one-size-fits-all” approach for implementing exercise programs with children with ASD. Every child is different regarding interests, competencies, and understanding of exercise. It is essential to understand each child as well as possible before the commencement of the program. The implementation of exercise programs for individuals with ASD should take into consideration the nature of the environment, communication, and instruction style. With these 3 factors considered, children
may be more likely to participate in exercise. Routine and structure may assist a child with being at ease within the exercise setting, resulting in familiarity rather than a disruption to routine. Positive reinforcement will empower a child to interact more and will build self-efficacy. Future research may need to review the application of current recommendations to coaching individuals with ASD of an adult population. A further study may be required to investigate and report on compliance levels to exercise, such as pedometer or accelerometer data. More research may include information on sensory diets, which may be used in the exercise classes. The recommendations provided in this article can aid strength and conditioning specialists and physical education teachers when implementing exercise and physical education classes for children with ASD. These recommendations may also be incorporated into a community setting and help integrate children and adults with ASD in sport participation.

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