Exercise Programming for Children with ASD: 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. Additionally, the manuscript 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.

KEYWORDS: special populations; neurotypical; autistic; program design; guidelines.

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 is divided into two 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, 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 two 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 three 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 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 towards exercise participation due to complex social demands, and incidents of bullying and isolation during 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 as 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 hyper- or hypo-sensitive 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). Hypo sensitiveness may be noted as an under responsiveness 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 school 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), 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

Due to 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 towards 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 healthcare professionals that 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 adjust 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 to promote attentiveness and engagement (31,47).

Research has reported that over 96% of children with ASD report hyper and hypo-sensitivity across numerous realms, which may lead children to be over- or under-responsive to certain stimuli (22). It is recommended to investigate what level of sensory sensitivity the children may have prior to starting any exercise program in order 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 under-responsive 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, e.g., the plank. Children may display challenging behavior when they become

overstimulated and should be allowed to leave the exercise setting, accompanied by a teacher, in order to use a sensory room or quiet room to self-regulate. Once the child has self-regulated, they are encouraged to re-join the exercise class.

Figure 1 near here

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 to 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 to 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 gender (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 are 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 Application 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 Table 2 and Table 3.

Table 2 and 3 near here

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 via 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., (2010) 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 (ABA), 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 due to 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

While 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. Prior to 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 (see Table 1). This 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.

Table 1 near here

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 (see Figure 3), and "mirroring." Mirroring is where children mimic each other in performing various movements (see Table 2 and Table 3).

Figure 2 and 3 near here

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 three 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 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. Lastly, 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).

Figure 4 near here

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, 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).

Figure 5 near here

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 three 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 a 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 manuscript 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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APPENDIX

FIGURE LEGEND

Figure 1. Sensory stimuli recommendations.

Figure 2. Jumping Ladders.

Figure 3. Snatch the Bacon.

Figure 4. Bean Bag Scramble.

Figure 5. Cobra Stretch.

TABLE LEGEND

Table 1. Needs Analysis.

Table 2. Examples of Exercises at Week 1.

Table 3. Examples of Exercises at Week 8.

Table 1 Needs analysis

Needs Analysis	
Questions to parent before Exercise	Does your child have a repetitive movement, repetitive habit or calming movement?
	What are your child's likes?
	What are your child's dislikes?
	What was your child's previous experience of exercise like?
	What is your child most interested in presently?
	Does your child have any aversions to visual, auditory, or tactile sensations?
	Any other information you feel might be relevant for me to know about your child?
Questions before Exercise	Is the area suitable for the exercises being performed today and suitable for the sensory needs of the child/ren?
	Are all videos and pictures for instruction ready for display?
	Is all equipment ready? Preferably, equipment should be put out when being

	used and when instructions have been provided to the children.

Table 2. Sample exercises at the commencement of an exercise program

Phase of Session	Exercise	AMSC Targeted	Instructions
Warm Up	Traffic Lights	Acceleration, Deceleration and Reacceleration	Green Cone = Run Yellow Cone = Walk/ Slow Mot Red Cone = Stop
	Jumps & Landing	Jumping, Landing, and Rebounding Mechanics	Instruct children to perform a sa landing with feet apart, knees b motorbike handles.
Main Phase	Reaction Game	Throwing, Catching and Grasping	Commands children must follow knees, toes, etc. As soon as the must grasp the ball rapidly.
	Bean Bag Scramble	Throwing, Catching and Grasping	On "go" children run to the cente start position and throw the bean
	Army Crawl	Upper Body Pulling	Children lie prone and move in with their upper body to move fo
	Crab Walks	Anti-rotation and Core Bracing	Move in a crab walking moti forwards and backwards. Prog moving with their feet.
	Balloon Keep Up	Upper Body Pushing	The aim is for the children to m any part of their body e.g. head,
Cool Down	Popcorn	Upper Body Pulling & Pushing	Place the bean bags on the parac the parachute up and down, to m
	Stretches		Flexibility stretches: Butterfly (seated), knee hug, cobra stretch,

Table 3. Example of exercise at Week 8

Phase of Session	Exercise	Targeted	Instructions
Warm Up	Traffic Lights	Acceleration, Deceleration and Reacceleration	Green Cone = Run Yellow Cone = Walk/ Slow Motion Red Cone = Stop Blue Cone = Bunny Hops White Cone = Bear Crawl
	Floor is Lava	Lower Body Unilateral, Jumping, Landing, and Rebounding Mechanics	With all hoops placed around in a c hoop, not making contact with outsid
Main Phase	Reaction Game (Partners)	Throwing Catching and Grasping	One ball placed between partners. Fo (e.g., heads, shoulders, knees, toes) children must reach to grasp the ball
	Color Targets	Throwing Catching and Grasping	Children have their own ball and throwing, and catching the ball. Chil at a colored target and catch the ball.
	Inch Worm	Upper Body Pulling	In pairs, one child lies prone on the about a foot from their partner's head child on the ground holds onto their Their partner moves forward and t pattern.

	Crab Soccer	Anti-rotation and Core Bracing, Upper body and Lower body	Moving in a crab walking motion, for Two teams of 3 play soccer while rer
	Volleyball	Upper Body Pushing, Acceleration, Deceleration, and Reacceleration, Lower Body Bilateral & Unilateral	Two teams of 3 on either side of t Children must keep the balloon in the point when the balloon touches the centerline.
Cool Down	Popcorn	Upper Body Pulling & Pushing	Place bean bags on the parachute and parachute up and down to make the b
	Stretches		Flexibility stretches: Butterfly stretch knee hug, cobra stretch, toe touch (sta