

EXERCISE IDENTIFIED AS AN EVIDENCE-BASED PRACTICE FOR STUDENTS WITH AUTISM SPECTRUM DISORDER

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Abstract

Exercise has recently been identified as an evidence-based practice (EBP) for students with autism spectrum disorder (ASD; National Professional Development Center on Autism Spectrum Disorder [NPDC], 2015). The purpose of this article is to review how exercise was identified as an EBP and demonstrate how exercise can be implemented throughout the school day for students with ASD. The authors reviewed literature identified by the NPDC, as well as literature from recent systematic reviews related to exercise and ASD (Dillon, Adams, Goudy, Bittner, & McNamara, 2016; Lang et al., 2010; Sowa & Meulenbroek, 2012; Wong et al., 2015). Through this examination of literature, the authors found that moderate to vigorous aerobic exercise (e.g., jogging, aquatics) has been the most commonly used intervention for students with ASD. Outcomes (e.g., social, cognitive, physical) from the literature associated with aerobic exercise are outlined and defined. The authors identify and explain practical applications of aerobic exercise for use by practitioners across a variety of settings.

Keywords: *ASD; autism; exercise; evidence-based practice*

According to the Centers for Disease Control and Prevention (CDC, 2016), autism spectrum disorder (ASD) is among the most commonly diagnosed disabilities for children in the United States, with 1 in 68 children being diagnosed with ASD (CDC, 2016). Children with ASD may demonstrate repetitive behaviors, deficits in social and communication skills, and motor development delays that manifest prior to 36 months of age (American Psychological Association, 2013). Motor skill deficits have also been well documented in children with ASD and are correlated with deficiencies in social behavior and communication skills (MacDonald, Lord, & Ulrich, 2014; Pan, Tsai, & Chu, 2009; Provost, Lopez, & Heimerl, 2007; Staples & Reid, 2010). In addition to motor skill deficits, children with ASD are twice as likely to be overweight and almost five times more likely to be obese com-

pared with their typically developing peers (Broder-Fingert, Brazauskas, Lindgren, Iannuzzi, & Van Cleave, 2014). Physical education (PE), which has been shown to have a positive effect on students' health (e.g., weight, motor skills; Datka, 2015), can provide students with ASD with the opportunity to participate in meaningful physical activity, learn fundamental motor skills, and lead a healthy lifestyle across the life span.

The newly adopted Every Student Succeeds Act (ESSA; Lam, Mercer, Podolsky, & Darling-Hammond, 2016) acknowledges PE and health as part of a student's *well-rounded education* (Block, 2016). Within the law, the term *well-rounded education* replaces *core subjects* previously used in federal legislation. The ESSA (2015) also requires school districts to use evidence-based practices (EBPs) that have shown a statistically significant effect on student outcomes (Lam et al., 2016). Enhancing outcomes across learning domains (i.e., cognitive, affective, psychomotor) and increasing motor skill development in students with ASD is dependent upon teachers using rigorous criteria for EBPs (i.e., exercise). The purpose of this article is to review how exercise was identified as an EBP and provide examples of how exercise can be implemented throughout the school day for students with ASD.

NPDC Criteria for Establishing EBPs

The National Professional Development Center on ASD (NPDC, 2015) created criteria to classify and establish interventions as EBPs for use in schools. The NPDC's criteria for EBPs include (a) strategies or ideas based on empirical research in the field, (b) specific to different fields within education, (c) consistent in increasing behaviors with specific groups of students, and (d) dynamic rather than static instructional delivery. When evaluated against these criteria, the identified EBPs were shown to be effective when appropriately implemented with students with ASD. The NPDC inclusion criteria for exercise as an EBP consisted of (a) participants aged 0 to 22 years; (b) diagnosed with ASD; (c) intervention had to be behavioral, developmental, or educational; (d) method design had to compare an experimental condition to a control; and (e) intervention practices had to

generate behavioral, developmental, or academic outcomes.

For this article, the authors reviewed publications examined by the NPDC (2015), as well as literature from systematic reviews related to exercise and ASD (Dillon, Adams, Goudy, Bittner, & McNamara, 2016; Lang et al., 2010; Sowa & Meulenbroek, 2012; Wong et al., 2015). Based on their review of the literature, the authors concluded that moderate to vigorous aerobic exercise (e.g., jogging, aquatics) was the most commonly used intervention for students with ASD.

Aerobic Exercise

Exercise has been defined as “activities that demonstrate an elevated breathing pattern and heart-rate to demonstrate a moderate to vigorous physical exertion has taken place” (AFIRM Team, 2015, <http://afirm.fpg.unc.edu/node/662>). It is recommended that students with and without disabilities accumulate 60 minutes a day of moderate to vigorous physical activity at least three days a week, with aerobic exercises encompassing a majority of students physical activity each day (Physical Activity Guidelines Advisory Committee, 2008). The CDC (n.d.) defines aerobic physical activity as “activity in which the body’s large muscles move in a rhythmic manner for a sustained period of time” (A section,

para. 2). Vigorous aerobic exercise lasts 20 minutes or longer, at an intensity that challenges one’s cardiorespiratory/ cardiovascular fitness. The level of intensity is critical, as research has shown mild exercise to have little effect on behavior in students with ASD (McNealus, 2016). Throughout the NPDC and systematic reviews, aerobic exercise was indicated to be linked with improved outcomes specific to promotion of affective (e.g., social skills, self-esteem; Bass, Duchowny, & Llabre, 2009; MacDonald et al., 2011; Pan, 2010), psychomotor (e.g., motor skill development, healthy lifestyle; Fragala-Pinkham, Haley, & O’Neil, 2008; Lochbaum & Crews, 2003; Pan, 2010, 2011; Pitetti, Rendoff, Grover, & Beets, 2007; Rogers, Hemmeter, & Wolery, 2010; Yilmaz, Yanardag, Birkan, & Bumin, 2004), and cognitive (e.g., problem solving; Best & Jones, 1974; Cameron, Shapiro, & Ainsleigh, 2005; Kern, Koegel, & Dunlap, 1984; Kern, Koegel, Dyer, Blew, & Fenton, 1982; Nicholson, Kehle, Bray, & Van Heest, 2011; Rosenthal-Malek & Mitchell, 1997) skills. Table 1 summarizes the types of outcomes produced by exercise cited in peer-reviewed research studies. For these reasons, practitioners need to carefully design their classes using exercise as an EBP to meet the unique needs of their students.

Table 1
Summary of Exercise and Associated Outcomes for Individuals With ASD

Outcome	Exercise	Studies
Decreases in Stereotypical Behavior	Aquatics Exergaming Jogging Roller Skating	Pan, 2010; Yilmaz, Yanardag, Birkan, & Bumin, 2004 Anderson-Hanley, Tureck, & Schneiderman, 2011 Kern, Koegel, & Dunlap, 1984; Kern, Koegel, Dyer, Blew, & Fenton, 1982; Levinson & Reid, 1993; Nicholson, Kehle, Bray, & Van Heest, 2011; Prupas & Reid, 2001; Rosenthal-Malek & Mitchell, 1997; Watters & Watters, 1980 Powers, Thibsforsu, & Rose, 1992
Decreases in Aggression	Jogging	Allison, Basile, & MacDonald, 1991
Decreases in Off-Task Behavior	Jogging Roller Skating	Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Fragala-Pinkham, Haley, & O’Neil, 2008 Powers, Thibsforsu, & Rose, 1992
Increased Academic Engagement	Aquatics Bicycling Jogging	Best & Jones, 1974 Cameron, Shapiro, & Ainsleigh, 2005 Kern, Koegel, & Dunlap, 1984; Kern, Koegel, Dyer, Blew, & Fenton, 1982; Nicholson, Kehle, Bray, & Van Heest, 2011; Rosenthal-Malek & Mitchell, 1997
Increased Social Opportunities	Aquatics Bicycling Therapeutic Horsemanship	Pan, 2010 MacDonald, Jaszewski, Esposito, & Ulrich, 2011 Bass, Duchowny, & Llabre, 2009
Improved Attention	Exergaming Therapeutic Horsemanship	Anderson-Hanley, Tureck, & Schneiderman, 2011 Sowa & Meulenbroek, 2012
Increased Muscular Strength and Endurance	Aquatics Bicycling Jogging Snowshoeing	Fragala-Pinkham, Haley, & O’Neil, 2008; Pan, 2010, 2011; Rogers, Hemmeter, & Wolery, 2010; Yilmaz, Yanardag, Birkan, & Bumin, 2004 Lochbaum & Crews, 2003 Pitetti, Rendoff, Grover, & Beets, 2007 Todd & Reid, 2006

Examples of Activities to Implement Throughout the School Day

Exercise does not have to be exclusively utilized within the PE setting; it can be integrated into most any school or class setting. Exercise can be used to provide a break from traditional academics, as an incentive, or as a learning opportunity. Students with ASD should be provided with opportunities to engage in a variety of exercises, including those in structured or unstructured settings. Physical activities that could be implemented throughout the school day for students with ASD include instant activities, jogging, bicycling, and technology-enhanced physical activities (e.g., exergaming).

Instant Activities

Sustaining exercise for 60 minutes may be difficult for any individual. The American College of Sports Medicine (Garber et al., 2011) indicates that exercise activity can be accumulated during the day in bouts lasting 10 or more minutes to attain the 60-minute recommendation. When exercise is introduced, these 10-minute bouts may be more realistic for students with ASD.

Instant activities are short bouts of physical activity that are simple to understand and implement throughout the school day. They can be integrated at any time during the school day, but may be especially useful when student energy or focus drops and/or when behavioral issues arise. For example, students can participate in short games of a “physically active” Rock, Paper, Scissors as an instant activity in which they engage in whole body movements including jumping while playing the game (see Figure 1; Castelli &

Ward, 2012). Other examples include jogging in place near desks and bouncing on a physio ball or mini trampoline in the classroom.

Jogging

When developing an aerobic exercise program, the teacher should gradually increase the intensity and duration over time so the student can adapt to physiological changes (Garber et al., 2011). The most commonly used exercise intervention for students with ASD found in peer-review literature was jogging (Kern et al., 1984; Nicholson et al., 2011; Rosenthal-Malek & Mitchell, 1997). Jogging, defined as running slower than 6 miles/hr, is considered a moderate to vigorous physical activity (Ainsworth et al., 2011). Ways to increase jogging activities during the school day include inviting special education teachers to use the gymnasium space when not in use for PE (e.g., for indoor recess or brain breaks). Table 2 contains an excerpt from a lesson plan describing how jogging can be implemented within a class. Ways to increase jogging activities outside of the school hours include implementing an after-school running club or having open gymnasium time before and after school when students are encouraged to come and be physically active in jogging and other related tasks. In addition to improved fitness levels, encouraging students with ASD to participate in these after-school programs may lead to other positive physical and/or social outcomes.

Cycling

Throughout the day, varying types of exercise could be included in students’ daily routines including cycling on a traditional bike/tricycle or a stationary bike. As an exercise

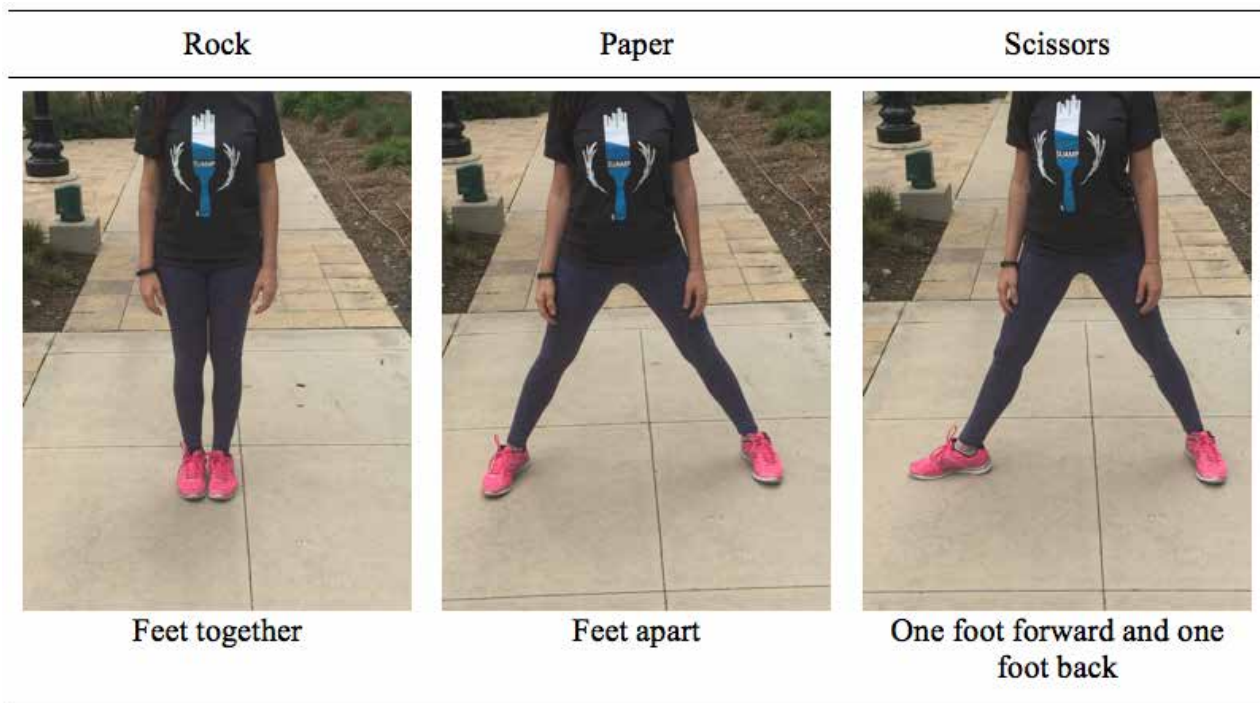


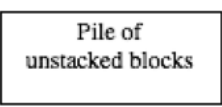


Figure 1. Jumping Rock, Paper, Scissors game. Adapted from Castelli and Ward (2012).

Table 2
Excerpt of Lesson Plan for Block Tower Relay

Title:	Block Tower Relay
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Team 1</p>  </div> <div style="text-align: center;"> <p>Team 2</p>  </div> </div> <div style="text-align: center; margin-top: 20px;">  </div>
Objectives:	Aerobic activity
Equipment:	20 large cardboard blocks, 2 polypots, 2 cones
Directions:	Place cones (each a different color) to indicate the start where students line up. Then place two polypots of corresponding color a safe distance apart (e.g., 6 feet) with the unstacked blocks in a pile behind. The farther the polypots are from the cones, the more aerobic activity the students will receive. On “go”, student 1 races to the blocks and stacks one on their polypot. Student 1 then runs back to their teammates and high-fives with the next student in line. Student 2 then runs to stack a new block on top of the previously placed block. Teams see how tall a tower they can make with their blocks or continue to play for a set amount of time (e.g., 5 min).
Verbal Cues:	“Run fast”, “Knees up”, “Use your arms”
Modifications:	Increase distance for added aerobic activity. Use other locomotor movements (e.g., galloping, skipping).
Grade Level	Pre-K through 4th
Source:	Heather Katz, Denton ISD Adapted Physical Education Specialist (2016)



Using Technology to Enhance Physical Activities

Technology has been shown to have a positive effect on engagement of students with ASD in activities that improve social, cognitive, and psychomotor learning outcomes, especially when used concurrently with exercise (Wong et al., 2015). Technology can create predictable environments and visual stimulation for learners with ASD and can increase the potential for independent participation. In addition, the use of technology, an established EBP on its own, is highly motivating and reinforcing (Takeo, Toshitaka, & Daisuke, 2007). Through the use of technology-aided instruction, students with ASD are able to engage in more on-task behaviors and may learn physical activity skills at a faster rate than without technology-aided instruction (Case & Yun, 2015). Table 3 lists examples of applications for handheld devices (e.g., iPads) that can be used throughout the school day.

Exergaming. One way of using technology to increase aerobic exercise is through the use of exergaming. With exergaming, gaming and technology are used to engage students in aerobic exercise, as body movements, reactions, and energy expenditure (i.e., heart rate, metabolic equivalent of task) are tracked through participation in the game (Trout & Christie, 2007). Anderson-Hanley, Tureck, and

activity, a stationary bike can be used to simulate riding a traditional bicycle or to replicate climbing a slope or descending a road (Yu, 1996). Limited research has been conducted on stationary bikes with students with ASD; however, research conducted on other forms of bicycles (e.g., adapted bikes) may be applied to stationary bikes (Mishin, Hunt, Decker, Coley, & Nelson, 2015). Stationary bikes can be used in the classroom as an individual exercise space.

Exercise and cycling technologies have led to a variety of options including tricycles, tandem, ergometer, balance, and recumbent bicycles, depending on the motor ability of the student. Cycling has been reported to increase self-confidence, as well as enhance peer and family relations for students with ASD (MacDonald, Jaszewski, Esposito, & Ulrich, 2011). In addition to the type of exercises (e.g., instant activities, jogging, cycling) suitable for students with ASD, it is equally important for teachers to consider how this activity is being delivered.

Schneiderman (2011) reported significant improvements in attention and working memory and decreases in stereotypical behaviors in students with ASD immediately after participating in a 20-minute exergaming intervention. Popular exergaming activities, including *Wii Sports* (Nintendo, 2006) and *Dance Dance Revolution* (Konami, 2016), can be implemented using an electronic device or a projector in an individual, small group, or large group setting. Exergaming can also be used as a behavioral reward or as a friendly competition among students.

Discussion and Conclusion

The purpose of this article was to explain the process through which exercise was identified as an EBP and to demonstrate how exercise can be implemented throughout the school day for students with ASD. Exercise has recently been established as an EBP for students with ASD (NPDC,

2015) with aerobic exercise being the primary intervention implemented in the majority of peer-reviewed articles reviewed by the NPDC. Although the NPDC has recognized exercise as an EBP, other research (e.g., Dillon et al., 2016; National Autism Center, 2015) suggests that additional high quality research is needed before exercise is considered an EBP for students with ASD.

Based on the studies reviewed for this article, aerobic exercise was linked to an array of improved outcomes (i.e., social, cognitive, physical, behavioral) in students with ASD. The ESSA (Lam et al., 2016) clearly defines and reinforces the requirement of school districts to use EBPs to improve student outcomes. The ESSA obligates schools to find, evaluate, and implement effective EBPs, such as exercise, that support high quality learning for all students. Teachers should use identified EBPs (e.g., exercise) as a tool for creating an individualized intervention program for students with ASD.

Regular aerobic exercise is important for all students, including those with ASD. With the prevalence of obesity being almost five times higher for children with ASD compared to their typically developing peers (Broder-Fingert et al., 2014), aerobic exercise is especially important for this specific population (World Health Organization, 2015). Fortunately, there are many opportunities (e.g., instant activities, jogging, bicycling, technology, exergaming) for exercise to be implemented throughout the school day, as well as occasions for students with ASD to benefit from exercise as an EBP.

Professionals' depth of understanding established EBPs (e.g., exercise, visual schedule, video modeling) may lead to stronger and more meaningful instruction for students with ASD in a variety of settings and content areas (e.g., PE, language arts). Specifically, if practitioners successfully used an array of EBPs when teaching PE curriculum standards, it would subsequently allow students with ASD to more effectively learn physical activity skills and increase their activity engagement.





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Table 3.
Examples of Wireless Application Technologies for Physical Activity

Applications for Handheld Devices	
 <p>ExerciseBuddy</p>	<p><i>ExerciseBuddy</i> (Geslak, 2015) is a video modeling application designed to help individuals with ASD exercise. Includes over 175 videos for fitness, locomotor, and object control skills.</p> <p>Cost: \$30</p>
 <p>Lazy Monster</p>	<p><i>Lazy Monster</i> (Mylnikau, 2016) is an application for exercise using body weight exercises (i.e., no equipment necessary). The workout lasts 7 minutes, with each exercise lasting approximately 30 sec.</p> <p>Cost: Free</p>
 <p>NFL Play 60</p>	<p>The <i>NFL Play 60</i> (American Heart Association, 2016) application is avatar controlled using own body movements to run and jump. Collect coins, level up, or compete against friends while learning and engaging in health and fitness.</p> <p>Cost: Free</p>
 <p>Adventures of Super Stretch</p>	<p>The <i>Adventures of Super Stretch</i> is a yoga app that uses 12 poses modeled after animals. Go start to finish through yoga poses or pick specific poses to complete.</p> <p>Cost: Free</p>

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