

Current Concept Review

Adaptive Sport Participation in the Pediatric Population

Sean A. Tabaie, MS MD, FAAOS¹; Jared A. Nowell, MD²; Emmanuel N. Osadebey, MD²; Jill Yastishak, CPNP¹;
Ryan S. Murray, MD³

¹Department of Orthopaedic Surgery and Sports Medicine, Children's National Hospital, Washington, DC; ²Department of Orthopaedic Surgery, Howard University Hospital, Washington, DC; ³Department of Orthopaedic Surgery, MedStar Georgetown University Hospital, Washington DC

Correspondence: Sean A. Tabaie, MS MD, FAAOS, 111 Michigan Ave., NW, Washington, DC 20010-2970. E-mail: stabaie@childrensnational.org

Received: April 3, 2022; Accepted: June 17, 2022; Published: August 1, 2022

DOI: 10.55275/JPOSNA-2022-0082

Abstract:

Adaptive sports are designed to enable children with disabilities to participate in athletic activities. The physical and mental health benefits of sports participation have been well-documented, and involvement in adaptive sports allows children with disabilities to experience these positive effects. In recent years, the available knowledge of the physical, mental, and psychosocial effects of sports, specific to disabled athletes, has grown.¹⁻⁷ Clinicians, parents, and athletes should be aware of the facilitators and barriers to adaptive sport to have the most efficacious experience. While athletes and parents are eager to start these activities, the purpose of this article is to provide a review of adaptive sports and recommendations for appropriate medical evaluations for aspiring athletes with disabilities.

Key Concepts:

- The health effects of adaptive sports participation in the pediatric population are not fully understood.
- A personalized preparticipation evaluation is necessary in the child with disability prior to involvement in sports.
- Facilitators and barriers to creation of adaptive sports programs must be acknowledged and explored to maintain successful and long-lasting opportunities.

Introduction

The impact of sports on children is a topic that continues to be investigated; but overall, sports have a benefit to

the growing child. In the early 2000s, this discussion began to shift to children with disabilities, and the

role that competition and health benefits have in this population.⁸ The earliest accounts of this specific subset of sports—adaptive sports—within the literature was in 1888. Currently, in the United States, 19% of children have a special healthcare need;⁹ however, the 2016-2017 National Survey of Children’s Health showed that the same population of children have statistically lower odds of being active compared to their peers without a special healthcare need.¹⁰ In recent years, there has been a growth of information and research being formed pertaining to this topic.¹¹ The purpose of this article is to review the current literature regarding the benefits, limitations, and areas of further investigation for adaptive sports in hopes of advancing pediatric-specific best practices.

What Are Adaptive Sports?

Adaptive sports are sports specifically for individuals with disabilities and encompass a wide spectrum of competitions similar to those for individuals without impairments.¹²⁻¹⁴ Modifications are created both in the rules of the game as well as the equipment that is involved in any individual adaptive sport.^{15,16} Criteria for participating in these activities include an individual experiencing a substantive persistent permanent disability affecting cognition function, visual acuity, motor function, or a combination of organ systems. Common participants in adaptive sports include but are not limited to those with Cerebral palsy, Down’s syndrome, Hemophilia, limb deficiency, or amputation. Adaptive sports exist at a variety of levels of competitions, from recreational community all the way to the elite professional level who participate in the Paralympic games (Figure 1).

Current Adaptive Sports Options

Adaptive sports have multiple outlets for individual participation. The level of competition ensures an entry point for essentially any person with a disability to be involved. A short list of the current organizations is the International Paralympic Committee, The American Association of Adapted Sports, Moved United, and a multitude of local community programs (Figure 2). Further information on options are listed in Table 1.



Figure 1. Ezra Frech is a 17-year-old American Paralympic athlete who competes in high jump, long jump, and sprinting events in international level events. He was born with congenital limb differences, he is missing his left knee and left fibula, and fingers on his left hand.



Figure 2. The American Association of Adapted Sports is an organization that provides services to local education agencies, state high school associations, and state departments of education in extracurricular adapted athletics for physically disabled children attending grades 1-12 to improve their well-being while positively influencing total student development.

Effects of Sports Participation in Athletes with Disability

Over the past decade, there has been increased investigation on the health effects of adaptive sport on

Table 1. Short List of Currently Available Adaptive Sport Options

Organization	Year Started	Mission Statement	Website
International Paralympic Committee	1989	To lead the Paralympic Movement, oversee the delivery of the Paralympic Games, and support members to enable Para athletes to achieve sporting excellence	https://www.paralympic.org
The American Association of Adapted Sports	1996	To expand and sustain a standardized structure for education-based athletic competition to improve the well-being of students with physical disabilities	https://adaptedsports.org
Move United	2020 from merger of Disabled Sports USA (1956) and Adaptive Sports USA (1967)	To provide national leadership and opportunities for individuals with disabilities to develop independence, confidence, and fitness through participation in community sports, including competition, recreation, and educational programs	https://www.moveunitedsport.org
Local community programs	Started in the 1900s	Variety of mission statements	Multitude of options

individual participants. portion of literature has focused on the pediatric population to identify the benefits and risks of involvement in this group of athletes.¹⁻⁷ This discussion will include health impact and psychosocial influences in the pediatric population.

Obesity and Physical Function

The rate of pediatric obesity is increasing worldwide, with reports as high as 19.6% in children and 18.1% in adolescents.¹⁷ Obesity can increase the risk of a variety of health conditions including diabetes, hypertension, sleep-disordered breathing, as well as stigmatization and bullying.¹⁸ A 2008 study in Australia compared overweight and obesity rates in children with intellectual disability, or global developmental delay, to children without those conditions. The study found 40% of children with cognitive disability were classified as overweight or obese compared to 23% of those without disability. The difference between these two groups reached statistical significance.¹⁸ Ryan et al. demonstrated this further finding that 45% of males and

56% of females with Down Syndrome meet the criteria of obesity.¹⁷

There is a paucity of research on the impact of adaptive sports on obesity rates in the pediatric population. Studies have used proxy measures when comparing those participants in adaptive sports to those that do not take part. It has been shown adaptive pediatric athletes reach a higher peak oxygen uptake level than their peers not in athletics. Additionally, their aerobic fitness, agility, and muscle strength were all positively associated with sports participation.⁴ A study by Di Russo et al. found participation in open skill sports such as basketball may facilitate recovery of executive function in athletes with physical disabilities (Figure 3).²

Feitosa and colleagues specifically evaluated a population of children with cerebral palsy to understand the effects of involvement in adaptive sports. After 1 year, children involved in adaptive sports had a statistically significant improvement in transfers and mobility as well as upper extremity and global function.⁶



Figure 3. Basketball has been shown to improve recovery of executive function in athletes with physical disabilities.

Bone Health

A recently published article in *Sports Medicine and Arthroscopy Review*¹² discussed how involvement in adaptive sports affects the bone health of the child athlete with disability. Current literature focuses on those with spinal cord injuries or cerebral palsy with a lack of information to make any conclusions about athletes with spina bifida, limb deficiency, short stature, or visual impairment. This article noted a positive effect on bone health attributed to increased weight-bearing and biomechanical demands (Figure 4).

Self-Perception and Community

Since the rise of adaptive sports, several studies have begun to look at the subjective effects that participation has had in the pediatric population. One of the first studies published in 2018, observed 195 children and adolescents with a physical or chronic disability to assess their own self-perception.⁷ The primary measure used was the Disabkids, also known as the DCGM-37, a questionnaire of 37 questions aimed to measure the quality of life and independence of children and adolescents with chronic health conditions.



Figure 4. Sports such as soccer allow for increased weight-bearing and biomechanical demands that provide a positive effect on bone health.

In a comparison of those who participated in sports at least twice a week to those who had less involvement, the children who were more active scored better on all

aspects of the DCGM-37 scale. Furthermore, children in this study had “higher feelings of social acceptance” after involvement in sports.⁷ This was not duplicated for the adolescents that were questioned with the current working theory being that adolescents have a wider social network beyond sports. Another study interviewed individuals who participated in a community-based wheelchair basketball club with an age range of 6-25 years old.⁵ After involvement in the league for a year, a total of four themes were found when speaking to the participants: positive social interactions, health and independence benefits, changing perceptions of disability, and meaningful occupation opportunities.

Preparticipation Evaluation

It is imperative that a full medical evaluation is performed in order to ensure the safety of a special need pediatric athlete.¹⁹ However, the standard preparticipation evaluation (PPE) for those involved in adaptive sports remains an area of research that needs to expand, as there is currently no clear recommendations for athletes, parents, or clinicians to follow.

A recent article in the *International Journal of Sports Physical Therapy* aimed to expand on the current PPE for individuals without impairment in order to modify it to those athletes with special health needs.²⁰ A collection of physiotherapists, sports medicine physicians, and physiatrists were surveyed and the aggregated results were analyzed to produce a consensus about information that would be most critical to evaluate prior to sports participation. The study created 10 questions to add to the existing PPEs to aid in improved evaluation of athletes with disabilities. Examples of the questions include “Do you have any visual disorders, including reduced vision in one or both eyes, difficulty with visual perception, color blindness, or designation as being legally blind?” and “Do you have a history of recurrent skin wounds or pressure sores?”

Formation of Adaptive Sport Programs

While the interest in participating in adaptive sports increases, the formation of programs remains a

substantive barrier. Literature has begun to investigate the aspects that aid in facilitating the entry into adaptive sports.

Facilitators

Two studies made it clear that it takes both a strong support from the surrounding community as well as the individuals involved in running the program itself for these programs to start and continue to run effectively. Wright et al.²¹ studied the perspectives of physicians and participants and found that “the right people make physical activity fun” and also “parent/family motivation and support and commitment” were important factors that lead to the success of adaptive sports programs. Iverson et al.²² noted that adaptive sport programs are more successful when they are facilitated by local communities. Encouragement and motivation of athletes were key in maintaining athlete participation in these activities. An additional finding in this study is that a patient navigator service was also preferred by participants and helped to increase the involvement in these activities. Individuals well versed in the sphere of the adaptive sports world were useful in recruiting and retaining individuals to stay involved in these activities.

The aim of the program is important. When the program’s mission statement focused on promoting success and inclusion rather than competition, it better suited the pediatric athlete.²¹ The pediatric population with impairments would rather be involved in a sport that encourages self-improvement rather than pitting two sides against each other and labeling one team as the winner and the other as a loser. While a competitive element may be gradually integrated later, at the early stages of adaptive sports, it is not a priority to be a part of the program.

Barriers

Wright et al.²¹ found the most noted barrier by young participants was “lack of accessible and inclusive opportunities” while the second most common barrier cited by physicians was “lack of accessible and inclusive participation pathways.” Lack of knowledge of resources

and a limited number of trained volunteers were two barriers in the study by Iverson et al. which contributed to the idea of access being a barrier for adaptive sports programs to exist.

Cost is a factor that impedes the formation of adaptive sports programs or athletes being able to participate.^{17,21,22} Specialized equipment is often required and is typically more expensive than that used in non-adaptive sports leagues.¹⁷ Unfortunately, these costs fall to parents, in addition to costs of league registration and travel expense.^{1,22,21} As adaptive sport programs continue to grow, an answer to the issue of cost needs to be formulated to allow larger participation.

Lastly, time required to live with disability and to perform activities of daily living may hamper involvement in sports. Ultimately, even under ideal infrastructure, participation in adaptive sport may be curtailed due to individual scheduling conflicts for personal or medical reasons given the presence of disability.

Adaptive Sports Equipment

The two major technologies that are utilized in a wide variety of conditions include wheelchairs and prostheses.

Wheelchair

Wheelchair use can be seen in basketball, rugby, track and field, and tennis just to name a few.^{15,16,23,24} When designing wheelchairs for sports, the guiding principles include optimizing the fit of the wheelchair to the individual while customizing the chair to the specific sport, which can include minimizing the weight or rolling resistance (Figure 5).²³

The individual involved in the activity may need to be situated in a recumbent position compared to a kneeling position, depending on their own specific disability.

The most common wheelchair injuries are abrasions, contusions, and injuries to tendons and ligaments.²³ Sports involving contact such as basketball and rugby often add front bumpers, spoke protectors, or adjust the angle of camber to protect hands, prevent



Figure 5. *Wheelchair rugby is an aggressive, high-impact sport, and the equipment, as a result, must be robust yet agile.*

entanglement, or even reduce the chance of athletes falling from the wheelchair.¹⁶ Placement of the wheels for propulsion closer to the body mass of athletes and using high pressure tires that are properly inflated may prevent overuse injuries for adaptive sports participants.^{23,24}

Prosthesis

One of the major factors to be considered to increase performance and decrease injury is the weight of the prosthesis, especially for sports that rely on speed^{25,16} as well as the type of shear and pressure stresses that will occur during a competitive activity. Lastly, it is important to consider the amount of energy that gets stored in the prosthesis and then returned, especially for speed sports like track and field, so that the performance of the athlete may be maximized. A recent review article by De Luigi et al.²⁵ goes into detail about sport-specific prostheses ranging from running and cycling all the way to cross country skiing and rock climbing. This is the most recent and in-depth discussion about these materials for adaptive sports athletes that we found during our literature search.

Summary

Adaptive sports remain a growing option for participation in sports for the child athlete with disability. Recent literature has begun to show the positive effects when a child is involved in adaptive sports. With the proper preparticipation evaluation, equipment, and well-trained facilitators to create effective programs, adaptive sports can have a profound impact on a child's life. As this field continues to advance and grow, continued research of these activities are imperative in hopes of optimizing the experience. Adaptive sports can be an integral part of a child's life, and orthopaedic surgeons are urged to encourage parents and children to take advantage of these opportunities.

Disclaimer

S. Tabaie: Paid consultancies for OrthoPediatrics, J&J Depuy-Synthes; the other authors have no conflicts of interest to disclose.

References

- Diaz R, Miller EK, Kraus E, et al. Impact of adaptive sports participation on quality of life. *Sports Med Arthrosc Rev*. 2019;27:73-82.
- Di Russo F, Bultrini A, Brunelli S, et al. Benefits of sports participation for executive function in disabled athletes. *J Neurotrauma*. 2010;27:2309-2319.
- Lape EC, Katz JN, Losina E, et al. Participant-reported benefits of involvement in an adaptive sports program: a qualitative study. *PM R*. 2018;10:507-515.
- Lankhorst K, Takken T, Zwinkels M, et al. Sports participation, physical activity, and health-related fitness in youth with chronic diseases or physical disabilities: the health in adapted youth sports study. *J Strength Cond Res*. 2019;35(8):2327-2337.
- Moss P, Lim KH, Prunty M, et al. Children and young people's perspectives and experiences of a community wheelchair basketball club and its impact on daily life. *Br J Occup Ther*. 2020;83:118-128.
- Feitosa LC, Muzzolon SRB, Rodrigues DCB, et al. The effect of adapted sports in quality of life and biopsychosocial profile of children and adolescents with cerebral palsy. *Rev Paul Pediatr*. 2017;35:429-435.
- Te Velde SJ, Lankhorst K, Zwinkels M, et al. Associations of sport participation with self-perception, exercise self-efficacy and quality of life among children and adolescents with a physical disability or chronic disease—a cross-sectional study. *Sports Med Open*. 2018;4:38.
- Wind WM, Schwend RM, Larson J. Sports for the physically challenged child. *J Am Acad Orthop Surg*. 2004;12:126-137.
- Carbone PS, Smith PJ, Lewis C, et al. Promoting the participation of children and adolescents with disabilities in sports, recreation, and physical activity. *Pediatrics*. 2021;148:e2021054664.
- Ross SM, Smit E, Yun J, et al. Updated national estimates of disparities in physical activity and sports participation experienced by children and adolescents with disabilities: NSCH 2016-2017. *J Phys Act Health*. 2020;17:443-455.
- Gold JR, Gold MM. Access for all: the rise of the paralympic games. *J R Soc Promot Health*. 2007;127:133-141.
- Blauwet CA, Borgstrom HE, Tenforde AS. Bone health in adaptive sports athletes. *Sports Med Arthrosc Rev*. 2019;27:60-66.
- Rudolph L, Willick S, Teramoto M, et al. Adaptive sports injury epidemiology. *Sports Med Arthrosc Rev*. 2019;27:e8-e11.
- O'Malley K, Kent T, Arginatar E. Surgical considerations in the adaptive athlete. In: *Adaptive Sports Medicine*. Cham: Springer; 2017.
- Oh H, Johnson W, Syrop IP. Winter adaptive sports participation, injuries, and equipment. *Sports Med Arthrosc Rev*. 2019;27:56-59.
- Matsuwaka ST, Latzka EW. Summer adaptive sports technology, equipment, and injuries. *Sports Med Arthrosc Rev*. 2019;27:48-55.
- Ryan JB, Katsiyannis A, Cadorette D, et al. Establishing adaptive sports programs for youth with moderate to severe disabilities. *Preventing School Failure*. 2014;58:32-41.
- De S, Small J, Baur LA. Overweight and obesity among children with developmental disabilities. *J Intellect Dev Disabil*. 2008;33:43-47.
- Mirabelli MH, Devine MJ, Singh J, et al. The preparticipation sports evaluation. *Am Fam Physician*. 2015;92:371-376.
- Hawkeswood JP, O'Connor R, Anton H, et al. The preparticipation evaluation for athletes with disability. *Int J Sports Phys Ther*. 2014;9:103-115.
- Wright A, Roberts R, Bowman G, et al. Barriers and facilitators to physical activity participation for children with physical disability: comparing and contrasting the views of children, young people, and their clinicians. *Disabil Rehabil*. 2019;41:1499-1507.
- Iverson M, Ng AV, Yan AF, et al. Navigator role for promoting adaptive sports and recreation participation in individuals with disabilities. *Am J Phys Med Rehabil*. 2020;100:592-598.
- Cooper RA, De Luigi AJ. Adaptive sports technology and biomechanics: wheelchairs. *PM R*. 2014;6:S31-S39.
- Goosey-Tolfrey V. Supporting the paralympic athlete: focus on wheeled sports. *Disabil Rehabil*. 2010;32:2237-2243.
- De Luigi AJ, Cooper RA. Adaptive sports technology and biomechanics: prosthetics. *PM R*. 2014;6:S40-S57.