Pediatric Athletes With Physical Disabilities

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It is estimated that there are about 40 million physically challenged persons in the United States; about 12% of school-age children have physical disabilities. More than 3 million persons with physical and mental disabilities are involved in organized sports, and many more in recreational physical activities. There is a wide spectrum of physical, mental, and sensory disabilities (see sidebar). Some of the commonly used terms in the context of this discussion are briefly defined in Table 1.

Athletes with various medical conditions have different capabilities for physical performance. Even athletes with the same medical condition can differ widely in their capacity for physical and mental performance on a given task. It is therefore necessary to classify athletes with disabilities based on their functional capabilities. Such functional classification takes into account the specific disability, nature of the sport, use of adaptive equipment by the athlete, and observation of the athlete during a given task. Trained and certified personnel classify athletes with disabilities. Grouping athletes with similar functional capabilities levels the playing field.

In addition to appropriate classification, a careful preparticipation evaluation (PPE) is important to identify specific medical issues with implications for sport participation. PPE also provides a setting to explore psychosocial issues that might be of relevance for the child and the family. PPE of a child with physical disability should ideally be conducted by the health-care professional most familiar with the athlete’s medical condition, who should be knowledgeable about the specific disability and its medical implications for sport participation. The purpose of the PPE is to appropriately match the athlete with a given sport. In addition to specific assessment of the disability, a thorough medical history should include general questions applicable to all athletes (see sidebar on next page). Musculoskeletal and neurologic assessment should be part of a careful physical examination. Any special equipment, orthotics, or other adaptive and assistive devices used by the athlete should be carefully evaluated by a knowledgeable health-care professional.

Key Points

All children with physical disabilities can be appropriately matched with different sport activities
Children with physical disabilities derive great psychological and physical benefits from sport participation.
Special attention should be given to the unique medical needs of children with specific disabilities
Key Words: autonomic dysreflexia, myelomeningocele, Down syndrome

Major Physical Disabilities

Cerebral palsy
Myelomeningocele and other neural-tube defects
Spinal-cord injuries
Limb amputations
Traumatic brain injury
Sensory impairment: vision and hearing deficits
 Neuromuscular disorders
ing hyperthermia, as well as hypothermia. They have reduced capacity for heat loss because of impaired sweating below the level of the lesion, thus reducing the effective body-surface area for evaporative cooling. Because of poor muscle tone and contractions there is venous pooling in the lower limbs and decreased venous return. This limits the body’s ability to lose heat by convection and radiation. An athlete with hyperthermia might have increased fatigue, headache, lightheadedness, muscle aches, nausea, vomiting, neurologic impairment, increased core temperature, and impaired sweating.¹ ⁴ ⁹

Hypothermia is also a risk for these athletes. There is loss of sensation below the level of the lesion, and the athlete might not be aware of wet clothes. Motor function is also impaired, and there is decreased muscle mass and reduced capacity to generate heat from muscle contractions.¹ ⁴ ⁹ Central thermoregulation is also impaired in these athletes, further increasing the risk for hypothermia. An athlete with hypothermia feels confused and cold and might have slurred speech.⁴ Cardiac and respiratory complications can result if this is not promptly recognized and treated. Athletes with spinal-cord injury are at risk for hypo-

### Thermoregulation

The ability to regulate body temperature is centrally mediated and is lost in athletes with spinal-cord injuries or lesion, especially with a lesion above thoracic 8.² ⁴ ⁹ These athletes are at increased risk for developing hyperthermia, as well as hypothermia. They have reduced capacity for heat loss because of impaired sweating below the level of the lesion, thus reducing the effective body-surface area for evaporative cooling. Because of poor muscle tone and contractions there is venous pooling in the lower limbs and decreased venous return. This limits the body’s ability to lose heat by convection and radiation. An athlete with hyperthermia might have increased fatigue, headache, lightheadedness, muscle aches, nausea, vomiting, neurologic impairment, increased core temperature, and impaired sweating.¹ ⁴ ⁹

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### Table 2. Terminology

<table>
<thead>
<tr>
<th>Term</th>
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<tr>
<td>Impairment</td>
<td>Any loss or abnormality of psychological, physical, or anatomical structure or function</td>
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<td>Disability</td>
<td>Any restriction or lack (resulting from impairment) of an ability to perform an activity in the manner or within the range normal for a human being</td>
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<td>Handicap</td>
<td>A disadvantage for a given individual that results from impairment or a disability that limits or prevents the fulfillment of a role that is normal for that individual</td>
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<td>Adapted sport</td>
<td>A sport that is modified or especially designed for athletes with disabilities</td>
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<td>Paralympic Games</td>
<td>Games for athletes who have physical disabilities or visual impairment</td>
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<tr>
<td>Special Olympics</td>
<td>A sport training and competition program for persons with mental retardation who are age 8 years and older, irrespective of their abilities</td>
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### Key Elements of PPE History

- Known medical conditions
- Recent febrile illness
- Past history of major surgeries
- Medications or supplements used by athlete
- Known allergies
- History of syncope
- History of palpitation, chest pain, heart murmur, high blood pressure
- Family history of premature cardiac death or other cardiovascular disease
- History of head or neck injury
- Difficulty breathing
- Hearing or vision problems
- Weight-control practices
- Immunization status
- Menstrual history in females

This brief review focuses on selected medical problems of athletes with major physical disabilities that require special consideration in terms of their participation in sports.⁷ ⁹
thermia and hyperthermia even within a narrow range of ambient-temperature changes.\textsuperscript{1,9} 

**Autonomic Dysreflexia**

Autonomic dysreflexia is the loss of central control over the autonomic nervous system, especially with lesion at and above thoracic 6.\textsuperscript{10-12} Essentially, there is a loss of inhibitory control of the sympathetic nervous system, resulting in an exaggerated sympathetic response. Certain specific stimuli below the level of the lesion can trigger such a response, including urinary bladder distension, urinary-tract infection, pressure sores, bowel distension, acute fracture of the lower limb, thrombophlebitis, and tight clothing.\textsuperscript{1,4,9,12} Autonomic dysreflexia is clinically manifested by headache, acute increase in blood pressure, cardiac dysrhythmias, chest tightness, feelings of apprehension, abdominal discomfort, diarrhea, and increased sweating above the level of the lesion.\textsuperscript{4,9,12} Acute increase in blood pressure and cardiac dysrhythmias can be life threatening and require prompt transfer of the athlete to an emergency medical facility. It is important to be aware of the possibility of autonomic dysreflexia in spinal-cord-injured athletes so that it can be promptly recognized. If such a problem is suspected, the athlete must be removed from competition, the triggering stimulus identified and eliminated (such as removing tight clothing, emptying the distended bladder), and the athlete transferred to an emergency medical facility. Fortunately, in many instances this is a self-limited response and resolves once the offending stimulus is eliminated.

The term *boosting* refers to the practice of self-induced autonomic dysreflexia.\textsuperscript{10} Some athletes knowingly induce autonomic dysreflexia to trigger a sympathetic response that might improve their performance—for example, improving race time in a wheelchair athlete. Major sport-governing bodies ban such a practice, and it is important to educate athletes on the serious risks associated with autonomic dysreflexia.

**Loss of Bladder and Bowel Control**

Children and adolescents with spinal-cord injury, myelomeningocele, or neuromuscular disorders can have loss of voluntary control of bowel and bladder function.\textsuperscript{11} Athletes with loss of bladder control might be on a scheduled regimen of intermittent self-catheterization or might have an indwelling catheter. Urinary retention and bladder distention can increase the risk of bladder infection and can trigger autonomic dysreflexia. It is important for these athletes to adhere to their prescribed therapeutic regimen. Long competition or practice sessions and lack of access to appropriate facilities can interfere with an athlete’s ability to adhere to the scheduled regimen. Similarly important is to adhere to the prescribed bowel regimen to avoid constipation, stool retention, and rectal distention. It is also important to recognize that accidents and odors can be causes for embarrassment for the athlete. Awareness, proper education regarding the importance of following the treatment, proper hydration, and access to appropriate facilities are important considerations for these athletes.

**Pressure Sores**

Athletes with spinal-cord injuries, those with other spinal-cord lesions such a myelomeningocele, athletes who are in wheelchairs, and amputee athletes with limb prosthetics are all at risk for developing pressure sores or decubitus ulcers over areas of sensory loss and increased friction and pressure.\textsuperscript{1,2,5,9,11} Early lesions might go unrecognized because of lack of sensation and can become infected. Infection can potentially lead to serious complications such as osteomyelitis of the underlying bone; thus it is extremely important to perform thorough and frequent skin checks of these athletes, and pressure sores must be aggressively treated. A localized redness and blistering might be the only early signs.\textsuperscript{1,2,4} Pressure and friction must be removed, and adequate padding must be provided to the area. Any skin breakdown must be appropriately cleaned and dressed, and signs of infection should prompt consideration of treatment with antibiotics.

**Cerebral Palsy**

Cerebral palsy results from an insult to the developing brain. It is characterized mainly by abnormalities of motor development, especially increased spasticity, and difficulties with movement and balance.\textsuperscript{3-11} Children with cerebral palsy are at an increased risk for various orthopedic complications including hip
dislocation, scoliosis, and joint contractures.\textsuperscript{2,4,8,11} They can also have difficulties in communication, hearing, and vision; seizures; and mental retardation. Cerebral palsy is diagnosed during infancy and is a nonprogressive condition. It is classified based on the predominant motor disability (hemiplegia, diplegia, quadriplegia) and on movement disorder (athetoid, dystonic, ataxic).\textsuperscript{11} Children with cerebral palsy have a wide variation of degree of disability, ranging from normal mental development to severe mental retardation and from minimal motor dysfunction to disabling quadripareses.

Children with cerebral palsy have decreased flexibility, decreased strength, poor balance, decreased anaerobic power, perceptual motor problems, and impaired hand–eye coordination.\textsuperscript{1,2,3,9,11} Their exercise capacity might be limited by increased cost of breathing and mechanical inefficiency of the motor movements. Athletes with cerebral palsy are therefore at an increased risk for various overuse syndromes.\textsuperscript{13,14} Decreased flexibility of the quadriceps and hamstrings contributes to proximal migration of the patella. Hip development is deficient and is further complicated by decreased hip flexibility and muscle-strength imbalance around the hips, which contributes to hip dislocations. Lower extremity flexion contractures lead to increased lumbar lordosis and increase the risk for spondylolysis. Sport participation is further affected by impaired coordination, impaired visual-perceptual abilities, and ankle and foot contracture deformities.

For the purpose of sport participation, the United States Cerebral Palsy Athletic Association categorizes athletes into eight categories based on observed functional ability and testing for various tasks. Training and conditioning programs for athletes with cerebral palsy should take into consideration their inherent medical problems.

**Myelomeningocele**

Myelomeningocele\textsuperscript{1,3,9,11} is an open-neural-tube defect resulting from failure of the closure of the spine and neural tube during their embryogenic development. Such open defects are recognized at birth or prenatally and are surgically closed within the first few days of life. The open defect can affect the brain or the spinal cord, meninges, and spine at various levels. Most of the defects (75\%) are at the lumbar level and result in paralysis and loss of sensation of the lower extremities, as well as loss of bladder and bowel control. Most of the affected children develop increased cerebrospinal-fluid pressure and increased size of the ventricles in the brain (hydrocephalus). Treatment requires placement of a ventriculoperitoneal shunt to relieve increased pressure in the ventricles of the brain.

Myelomeningocele is associated with other medical problems including various orthopedic deformities of the lower extremities, neuromuscular scoliosis, seizures, growth failure, cognitive and learning difficulties, vision problems, and sexual dysfunction. It also involves difficulties with hand–eye and foot–eye coordination. These athletes have decreased aerobic and anaerobic power, decreased endurance, and mechanical inefficiency.

Like spinal-cord-injured athletes, athletes with myelomeningocele typically participate in sports as wheelchair athletes. Overuse injuries of the shoulders and wrists are the most common injuries in wheelchair athletes; carpal tunnel syndrome is reported in 50–75\% of them. A specific consideration for athletes with myelomeningocele is allergy to latex, with a reported prevalence of 25–65\%. It is important to avoid the use of latex-containing materials, which include latex gloves, blood-pressure cuffs, catheters, bulb syringes, stethoscope tubing, wound drains, certain bandages, shoe soles, and sport equipment.\textsuperscript{1,3,9}

**Sensory Impairments**

Sensory impairments\textsuperscript{1,3,9,11} such as hearing loss can range from mild to profound. Deaf athletes have no specific restrictions from sport participation. They might have some disadvantage in following vocal directions, but with continued practice, these athletes adapt and with some visual cues are able to participate fully in sports.

Like deafness, visual impairment can range from mild or partial to complete blindness. These athletes typically have no other impairments. In fact, participation in sports or other physical activities facilitates the acquisition and development of motor skills. The United States Association for Blind Athletes sets standards and organizes sport events for visually impaired athletes 14 years and older. These athletes are categorized based on residual vision and can participate in many sports, some modified or adapted for them,
including skiing, track and field events, swimming, cycling, gymnastics, running, bowling, golf, and bicycling.

**Down Syndrome**

Down syndrome\(^2,11,15\) is a genetic syndrome characterized by mental retardation and characteristic dysmorphic features and is associated with a number of other abnormalities including congenital heart defects, visual impairment, hearing loss, endocrine disorders, and orthopedic abnormalities.\(^11,15\) Of particular interest is the increased laxity of ligaments and decreased muscle tone. Increased laxity of ligaments in the cervical spine coupled with decreased muscle tone can increase the risk for subluxation of the atlantoaxial joint. Atlantoaxial instability occurs in about 15% of individuals with Down syndrome, 2% of whom might be symptomatic. Symptoms of atlantoaxial instability include abnormal gait, increased fatigue, neck pain and decreased range of motion, torticollis, incoordination, spasticity, clonus, exaggerated deep tendon or stretch reflexes, extensor plantar reflex, sensory deficits, other upper motor-neuron signs, and posterior-column signs.\(^1-3,15\)

Athletes with Down syndrome and asymptomatic atlantoaxial instability present a diagnostic and management dilemma because of their increased risk for subluxation and spinal-cord injury. All athletes with Down syndrome are clinically and radiographically screened and evaluated to identify athletes at risk. Because of increased risk for atlantoaxial subluxation with excessive neck flexion–extension, some sports are contraindicated: contact collision sports, gymnastics, diving, pentathlon, butterfly stroke, high jump, soccer, diving starts in swimming, and certain warm-up exercises that involve neck flexion–extension.\(^2,3,15\)

**References**


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