The Sports Preparticipation Evaluation

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Practice Gaps

Lack of familiarity with current recommendations diminishes the confidence to perform a preparticipation physical evaluation (PPE). In a 2014 survey, Madsen et al (1) reported, "Only 37% of physicians reported an awareness of the PPE Monograph." (2) Clinicians should be aware of current guidelines for performing a PPE and identify children who may be at increased risk from sport participation.

Objectives After completing this article, readers should be able to:

1. Perform a preparticipation history and physical examination and identify children and adolescents who may be at increased risk for morbidity or mortality from sport participation.
2. Recognize that the mandatory preparticipation physical evaluation serves as an opportunity to address medical and psychosocial issues not necessarily associated with sport participation and as an entry point for healthy adolescents into the health-care system.
3. Recognize the cardiac risks associated with sport participation and when additional cardiac evaluation is required.
4. Understand the importance of assessing and documenting neurocognitive function before sport participation.
5. Identify which sports are appropriate for athletes with some common medical conditions.
6. Recognize the effect of a febrile illness on sport participation.

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ABBREVIATIONS

AAP	American Academy of Pediatrics
AAS	anabolic-androgenic steroid
AHA	American Heart Association
BP	blood pressure
CDC	Centers for Disease Control and Prevention
DM	diabetes mellitus
ECG	electrocardiography
FDA	Food and Drug Administration
LVH	left ventricular hypertrophy
PES	performance-enhancing substance
PPE	preparticipation physical evaluation
SCAT5	Sports Concussion Assessment Tool, Version 5
SCD	sickle cell disease
SCT	sickle cell trait

INTRODUCTION

In the United States, sport participation is increasing, with more than 60 million children and adolescents competing in organized sports every year. The number of high school athletes has increased from 7.2 million to 7.9 million during the past 10 years. (3) The physical and psychosocial benefits of sport participation are well-documented, and pediatricians serve a vital role in promoting physical activity. As a pediatrician who is trusted to provide guidance on the health and safety of our children, it is important to be knowledgeable about the current recommendations and controversies regarding the preparticipation physical evaluation (PPE).

The American Academy of Pediatrics (AAP) along with 5 other organizations, including the American Academy of Family Physicians, the American College of Sports Medicine, and the American Medical Society for Sports Medicine, developed the Fourth Edition of the PPE Monograph, (2) which was released in 2010 and describes the standard of care for the PPE. It is a useful and accessible document that offers a standardized approach to the PPE that should be adopted by the pediatric clinician. The Fifth Edition is anticipated to be released soon.

The primary objective of the PPE is to screen for potentially life-threatening conditions or conditions that may put the athlete at risk for injury or illness. Although the PPE has been routinely performed for almost 40 years, there is much discussion as to whether it achieves the intended outcomes. Recently, this debate has centered on cardiac screening and particularly the use of electrocardiography (ECG) to identify potentially life-threatening arrhythmias and structural congenital heart disease. In the United States, ECG has not been a recommended component of a routine PPE due to concerns related to the sensitivity and specificity of the ECG as a screening tool in young athletes. The American Heart Association (AHA) currently recommends a thorough personal history, family history, and physical examination for preparticipation cardiovascular screening of competitive athletes. (4)

However, it is not just ECG screening that has questionable utility. The entire PPE has a remarkably small evidence base to suggest any efficacy for improving the health of young athletes. However, most clinicians still feel that it is an important part of preventive medicine, primarily because the PPE serves as an entry point into the health-care system for otherwise healthy adolescents. For many young athletes, clearance for sports may be the only reason they will have an encounter with a health-care provider. Similar to a well-child examination, this allows the pediatrician to assess the overall health of the young athlete, review the personal and family history, and discuss important psychosocial and medical topics with the patient. In addition, the PPE serves as an opportunity to educate the athlete about topics such as injury prevention, performance-enhancing supplements, concussion, etc. The PPE is also commonly required to fulfill the legal and insurance requirements for participation in athletic activity.

TIMING AND SETTING

Athletes should be encouraged to complete their PPE at least 6 weeks before the first practice. This allows for further investigation or treatment of any issues identified during the evaluation without unnecessarily restricting or delaying sport participation. The beginning of summer or near the end of the previous school year is an ideal time. A comprehensive PPE with a complete personal and family history and thorough physical examination should be performed at least every 2 years, with an annual review of the patient's history and a problem-focused examination as needed. However, because this is often the only interaction an adolescent athlete may have with a health-care provider, it is reasonable to perform a comprehensive evaluation as was done for annual health supervision visits for earlier ages.

The ideal setting is an individual office-based evaluation with the athlete's personal primary physician. Athletes should be encouraged to have a medical home and to have their PPE performed by their primary clinician. This leads to greater continuity of care and allows access to medical records. The athlete's primary care physician is often more familiar with the athlete's previous issues and family history. The primary care physician is also better able to identify changes over time and react appropriately. Many health insurance companies reimburse for only 1 preventive visit per 12 months, so it is reasonable to incorporate the PPE into the annual health supervision visit. Providers may choose to include the components of the PPE as part of the annual health supervision visit for all patients because physical activity should be encouraged regardless of sport participation.

Mass PPE events, such as a group evaluation in a gymnasium or locker room, should be discouraged for several reasons. The close quarters may limit privacy and discourage disclosure of potentially embarrassing concerns for the athlete. These environments are often too noisy to perform an adequate cardiac examination. In addition, medical records are often unavailable or incomplete. A coordinated medical team may administer group evaluations and is an acceptable alternative to the individual office-based examination in certain circumstances. For example, at the collegiate or professional level, the sports medicine team, led by the team physician, may have extensive knowledge of the athlete's background and is well-suited to perform a thorough and adequate PPE. The primary advantage of the group PPE is increased efficiency. Often an entire team or school can complete their PPEs in a short period.

A variation on the mass PPE is the station-based evaluation. Multiple specialists may collaborate and each perform a portion of the evaluation. For example, an orthopedic surgeon may complete the musculoskeletal portion of the examination, a cardiologist may perform a cardiac examination, and a primary care physician may assimilate all of the information to make a determination for clearance to participate.

A physician, specifically the athlete's personal primary physician, is the preferred medical provider to perform the PPE. However, a variety of other health-care professionals may be permitted to complete the evaluation and clear an athlete, so it is important to know your local and state requirements regarding who has the authority to perform a PPE in your area.

HISTORY

Obtaining an accurate and thorough medical history is essential and has been shown to be much more sensitive for detecting abnormalities, such as a history of sickle cell trait (SCT), diabetes mellitus (DM), or seizure disorder, than the physical examination portion of the PPE. The medical history alone detects almost 90% of the medical conditions and 70% of the musculoskeletal conditions identified on the PPE. (5) Parents should be involved and contribute to this element of the PPE because studies have demonstrated poor correlation (<40% agreement) between athlete and parental reports of medical history. (6)

The Fourth PPE Monograph offers a form that is publicly available and encouraged for use among pediatric providers (Appendix A). Some states require a state-specific form that may not address all of the recommended historical components. Because this often serves as the only health examination that a young athlete may receive, additional history should be obtained whenever necessary. The history questions are broken down into several categories, and the importance of these issues are discussed in detail herein.

A history of disqualification from sport participation or restricted participation is a significant finding. Although approximately 10% (3.1%–13.9%) of athletes have a significant finding during the PPE that warrants further investigation or management before clearance, only 1% to 2% of athletes are ultimately disqualified from participation. (7) Therefore, it is reasonable to start by asking the patient whether he or she has ever been restricted or denied participation for any reason in the past.

MEDICAL HISTORY

A broad review of chronic medical conditions allows the provider to gain an understanding of the general health of the athlete and to ensure that any chronic conditions are appropriately managed before clearance for sport participation. For example, poorly controlled DM or asthma may place the athlete at increased risk for morbidity or mortality, regardless of sport participation. It is important to realize that the PPE offers an opportunity for the provider to address general medical concerns for the adolescent patient.

Diabetes

Aerobic exercise and strength training are generally beneficial for patients with DM. However, poor glycemic control or a poor understanding of how insulin and carbohydrate needs might change during exercise can put the diabetic athlete at risk for dangerous hyperglycemia or hypoglycemia. All children and adolescents with DM should be monitored by a clinician with expertise in diabetic management and should be encouraged to discuss the demands of their particular sport with this specialist. Furthermore, the athlete's coaches and on-site medical providers (such as Certified Athletic Trainers) should be competent in delivering emergency diabetic medications, such as glucagon for the treatment of extreme hypoglycemia. Rarely, complications of DM, such as retinopathy, neuropathy, nephropathy, or other microvascular disease, might affect the ability of the athlete to participate safely in sports.

Adequate glycemic control before exercise is imperative, and athletes should be educated on the risk of hypoglycemia during and after exercise, with recommendations for blood glucose monitoring before, during, and after exercise. It is important for the athlete and others to be knowledgeable about the athlete's DM to properly adjust insulin and carbohydrate intake. A DM ID bracelet or shoe tag is recommended to help expedite recognition and treatment of a hypoglycemic episode. Sports such as scuba diving, skydiving, and rock climbing are considered especially high risk for patients with DM due to the consequences of a hypoglycemic episode during these events.

Allergies

A history of a severe allergic reaction or anaphylaxis provides the opportunity to plan for an emergency. Two of the most common causes of anaphylaxis, insect envenomation and food allergies, are commonly encountered in the athletic setting as athletes are often practicing or competing outdoors or may be traveling for various competitions and eating in new environments. Any athlete who reports a previous severe allergic or anaphylactic reaction should be required to have injectable epinephrine on-site for immediate use, and coaches and medical staff should be educated on how to detect and treat potentially life-threatening allergic reactions.

Mononucleosis

There is an increased risk of splenic rupture within the first 21 days of illness in patients with infectious mononucleosis. However, splenic rupture rarely occurs beyond 28 days from the onset of symptoms. Unfortunately, physical examination has proved to have poor sensitivity for splenomegaly and

cannot be relied on to determine whether an athlete is at increased risk for splenic rupture. Ultrasonography is also unreliable in detecting splenomegaly due to variation among individuals and lack of defined "normal" spleen size. Because splenomegaly is almost universally present in patients with infectious mononucleosis and often persists for several weeks, physical activity should be restricted completely for 3 to 4 weeks from the onset of symptoms. Symptoms such as fatigue may limit the ability to return to athletic participation for longer periods.

Sickle Cell Trait and Disease

According to the Centers for Disease Control and Prevention (CDC), "sickle cell disease affects approximately 100,000 Americans" and "1 out of every 365 Black or African-American births." (8) Sickle cell trait is the presence of a single sickle cell gene (hemoglobin SA) and affects 1.5% of all US newborns and 7% of black newborns. (9) Acute exertional rhabdomyolysis is associated with SCT and is a leading cause of atraumatic death in athletes, behind only sudden cardiac death and exertional heat stroke. (10) Although athletes with SCT may safely participate in most sports, intense exertional activity performed in hot, humid, or high-altitude environments may lead to exertional sickling. This, in turn, causes vaso-occlusion and ischemia, which leads to rhabdomyolysis. Early recognition of an athlete with sickling collapse may prevent permanent end-organ damage and death. Screening of all athletes for SCT remains controversial but is mandated for National Collegiate Athletic Association athletes. It is important to ask the athlete and his or her family whether there is a family history of sickle cell disease (SCD) or whether the athlete has known SCT. Often, this information can be retrieved from the results of the athlete's newborn screen. Exertional sickling episodes may be prevented by modifying practice and conditioning (eg, avoiding repetitive sprints and/or allowing the athlete to work at his or her own pace with adequate recovery periods), particularly in hot or humid environments, maintaining hydration, and avoiding or acclimatizing to activity at higher altitudes.

The National Athletic Trainers' Association Consensus Statement on SCT (11) recommends the following:

- There is no contraindication to participation in sport for the athlete with SCT.
- Red blood cells can sickle during intense exertion, blocking blood vessels and posing a grave risk for athletes with SCT.
- Screening and simple precautions may prevent deaths and help athletes with SCT thrive in their sport.
- Efforts to document newborn screening results should be made during the PPE.

Although much has been written about screening and the care of the athlete with SCT, SCD in athletes is relatively unexplored. Children and adolescents with SCD (or other blood diseases) should be encouraged to participate in exercise. (12) However, sport participation in this group can be challenging. Sickle cell disease increases the athlete's risk of dehydration, heat injury, exhaustion, painful crises, and joint-related problems. These risks can be mitigated by either limiting exposure or gradually acclimatizing to heat, humidity, and/or high altitude. Similar to all athletes, those with SCD should have unrestricted access to water during practice and competition, and dehydration should be avoided.

Paired Organs

Absence of a paired organ (testicle, kidney, ovary, eye) does not disqualify a patient from athletic participation but may affect clearance for certain sports. Protective equipment may be recommended (such as a protective cup for an unpaired testicle or a flak jacket for a solitary kidney), particularly for high-impact or collision sports. Of note, kidney injury is more likely to occur from a fall from a bicycle than from playing contact sports.

Protective eyewear with American National Standards Institute–approved lenses made of polycarbonate is recommended for sports with a high risk of eye injury (eg, baseball, hockey, fencing, and racquetball). Full goggles with a strap to secure the lenses to the head are preferable because they not only offer prevention of eye injury but may also have prescriptive lenses to provide vision correction. Athletes should not be permitted to play sports in their standard eyeglasses. Contact lenses do not confer any eye protection.

Functionally 1-eyed (absence of 1 eye or best-corrected vision of $<20/40$ in 1 eye) athletes must wear protective eyewear with American National Standards Institute–approved lenses made of polycarbonate, even in noncontact and low-risk sports. These patients should not be allowed to participate in sports in which the eyes cannot be adequately protected (such as wrestling and full-contact martial arts) because the effects of loss of the good eye can be disastrous.

Acute Illness

Fever increases cardiopulmonary effort and disrupts the body's ability to dissipate heat and maintain thermoregulation, which increases the risk of heat illness. For reasons that are not completely clear, exercising with fever seems to increase the risk of symptomatic myocarditis, and athletes who are acutely febrile should not be permitted to train.

Acute upper respiratory tract infections are common, and athletes may be allowed to participate as long as symptoms remain in the head and neck (eg, pharyngitis, rhinitis, and sinusitis), but symptoms that involve the body, such as chest congestion, productive cough, or myalgias, may indicate a more serious infection and should preclude training and competition.

Supplements

All athletes should be asked about use of alcohol, tobacco, drugs, and performance-enhancing substances (PESs). The PPE offers an opportunity to discuss substance use and abuse with the young athlete and to counsel regarding associated risks. Performance-enhancing substances include dietary supplements as well as legal and illegal drugs, and PESs are commonly used or abused by young athletes to improve athletic performance and/or for aesthetic purposes. Some of the more commonly used PESs are protein, creatine, caffeine, and nonprescription diet pills. Use of PESs increases with age and is generally more prevalent in males (with the exception of diet pills). (13) Thirty-nine percent of 12th-grade males and 30% of eighth-grade males report taking protein supplements at some point, but the use of anabolic-androgenic steroids (AASs) is much lower, with an estimated 3.2% lifetime prevalence of AAS use among high school students. (14)

Concerns regarding PES use among adolescents include the adverse and long-term health effects, which are largely unknown in the pediatric population, as well as risks of contamination because these substances are not regulated by the Food and Drug Administration (FDA). In one study, 25% of over-the-counter supplements tested were contaminated with AASs, and 11% were contaminated with stimulants. (15)

CARDIOVASCULAR

Sudden cardiac death is a rare but devastating event. Young athletes are often perceived as models of fitness and health. When one of these young lives is lost in a sudden and unexpected manner, the tragedy often receives a large amount of publicity and media coverage. Fear of sudden cardiac death can lead parents, athletes, coaches, administrators, and medical providers to seek methods for preventing these events. Unfortunately, most athletes who are at risk for sudden cardiac death are asymptomatic until their fatal event, making it difficult to determine who is at risk.

Routine screening using ECG or echocardiography remains controversial, but most experts agree that a thorough personal and family history is important. In the United States, universal ECG screening is not currently required for young healthy people aged 12 to 25 years. However, targeted screening for certain high-risk populations is gaining acceptance.

The AHA has recommended a 14-element cardiovascular screen using the history and physical examination (Table 1). (4)(16)(17) Certain red flags in the athlete's medical or family history warrant further investigation to detect cardiac abnormalities that may increase risk of sudden cardiac death. In a previous *Pediatrics in Review* article, Peterson and Bernhardt (18) recommended the following: "Known congenital heart disease, cardiac channelopathies (such as long QT or Brugada syndrome), any history of myocarditis, and coronary anomalies such as those caused by Kawasaki disease should be evaluated by a cardiologist before sports participation. A personal history of syncope, near-syncope, chest pain, palpitations, or excessive shortness of breath or fatigue with exertion should prompt a more thorough evaluation, either by the primary clinician or a cardiologist. Postexertional syncope is a common occurrence that is frequently elicited in the PPE history. This benign condition should be differentiated from exercise-associated collapse, which occurs during exertion and is an ominous sign of hemodynamically significant cardiovascular disease or ventricular tachyarrhythmias. All patients who experience syncope should undergo electrocardiography, with further testing on a case-by-case basis."

A family history of early sudden cardiac death (before age 50 years), Marfan syndrome, cardiomyopathy, and arrhythmias (especially long-QT syndrome) should prompt further cardiovascular evaluation. Particular attention should be given to any family history of unexplained or poorly characterized deaths, such as those from drowning, unexplained motor vehicle accidents, sudden infant death syndrome, or seizures. These events may actually represent unrecognized sudden cardiac death. (18)

NERVOUS SYSTEM

There are several neurologic conditions that require further investigation before clearance. The most common are concussion or traumatic brain injury, exertional headaches, seizures, recurrent "burners" or "stingers," and transient quadriparesis.

A concussion is a brain injury caused by a direct or transmitted blow to the head that disrupts normal brain function. It is estimated that 1 to 2 million sport-related concussions occur annually in the United States. (19) Athletes frequently sustain more than 1 concussion over their lifetime. Contact or collision sports (Table 2) (20) have an

TABLE 1. **The American Heart Association 14-Element Cardiovascular Screening Checklist for Congenital and Genetic Heart Disease**

MEDICAL HISTORY[a]
Personal history
1. Chest pain/discomfort/tightness/pressure related to exertion
2. Unexplained syncope/near-syncope[b]
3. Excessive and unexplained dyspnea/fatigue or palpitations associated with exercise
4. Previous recognition of a heart murmur
5. Elevated systemic blood pressure
6. Previous restriction from participation in sports
7. Previous testing for the heart, ordered by a physician
Family history
8. Premature death (sudden and unexpected or otherwise) before 50 y of age attributable to heart disease in ≥1 relative
9. Disability from heart disease in a close relative <50 y of age
10. Hypertrophic or dilated cardiomyopathy, long-QT syndrome, or other ion channelopathies, Marfan syndrome, or clinically significant arrhythmias; specific knowledge of genetic cardiac conditions in family members
Physical examination
11. Heart murmur[c]
12. Femoral pulses to exclude aortic coarctation
13. Physical stigmata of Marfan syndrome
14. Brachial artery blood pressure (sitting position)[d]

[a]*Parental verification is recommended for high school and middle school athletes.*
[b]*Judged not to be of neurocardiogenic (vasovagal) origin; of particular concern when occurring during or after physical exertion.*
[c]*Refers to heart murmurs judged likely to be organic and unlikely to be innocent; auscultation should be performed with the patient in both the supine and standing positions (or with Valsalva maneuver), specifically to identify murmurs of dynamic left ventricular outflow tract obstruction.*
[d]*Preferably taken in both arms.*
Reprinted with permission from Maron BJ, Friedman RA, Kligfield P, et al. Assessment of the 12-lead electrocardiogram as a screening test for detection of cardiovascular disease in healthy general populations of young people (12-25 years of age): a scientific statement from the American Heart Association and the American College of Cardiology. J Am Coll Cardiol. *2014; 64(14), 1479-1514. Copyright 2014, with permission from Elsevier.*

increased risk of concussion compared with limited contact or noncontact sports.

During the PPE it is important to obtain a thorough concussion history, including number, date, symptoms, severity, and recovery from previous injuries. It is imperative that an athlete has fully recovered from the most recent concussion before returning to sport participation to reduce the risk of recurrent injury, second impact syndrome, or permanent neurologic sequelae. An athlete must be symptom-free, including during schoolwork, and must complete a graduated return to play progression before being fully cleared to return to sport. Several factors may prompt consideration of disqualification from contact sports, including increasing frequency or severity of injury, prolonged or incomplete recovery, or multiple concussions.

Baseline neurocognitive testing has become increasingly popular, although concerns regarding poor sensitivity, specificity, test-retest reliability, and intentional underperformance (sandbagging) have brought the utility of these tests into question. There are paper-and-pencil, verbal, and computerized versions of neurocognitive testing. The Sports Concussion Assessment Tool version 5 (SCAT5) (21) and the pediatric version (Child SCAT5) are brief neuropsychological test batteries that may be used for both baseline and postinjury assessments. Assessing and documenting neurocognitive function before sport participation allows for comparison with postinjury test results to ensure that the athlete has returned to their preinjury level of function before clearance to return to play. However, it should be made clear that neurocognitive testing should not be the only tool used to diagnose a concussion. Currently, there are no reliable diagnostic tests for sport-related concussion, and it remains a clinical diagnosis.

Headache with exertion is a common complaint and typically benign. Exercise-induced migraine headache can be differentiated from more common benign exertional headaches based on symptoms. Migraine headaches are pulsatile in nature and typically feature a prodromal aura, light and sound sensitivity, and/or nausea. Primary exercise headaches are steady or constant in nature and typically do not have additional coincident symptoms. Both types of headaches can be treated with exercise modification and/or over-the-counter analgesics. Migraine headache may also be treated with abortive medications, such as serotonin receptor agonists (triptans). Neither migraine headaches nor primary exercise headaches are a contraindication to sport participation. Rarely, more malignant causes of headache, such as increased intracranial pressure, intracranial mass, or unresolved intracranial hemorrhage, may present as exertional headaches. Red flags such as papilledema, night headaches, headaches on awakening, neurologic deficits, or other neurocognitive decline

TABLE 2. **Classification of Sports by Contact Type**

CONTACT OR COLLISION	LIMITED CONTACT	NONCONTACT
Basketball	Baseball	Archery
Boxing[a]	Bicycling	Badminton
Diving	Canoeing or kayaking (white water)	Bodybuilding
Field hockey	Cheerleading	Bowling
Football, tackle	Fencing	Canoeing or kayaking (flat water)
Ice hockey[b]	Field events	Crew or rowing
Lacrosse	Floor hockey	Curling
Martial arts	Football, flag	Dancing (ballet, modern, jazz)[c]
Rodeo	Gymnastics	Field events (discus, javelin, shot put)
Rugby	Handball	Golf
Ski jumping	High jump	Orienteering[d]
Soccer	Horseback riding	Power lifting
Team handball	Pole vault	Race walking
Water polo	Racquetball	Riflery
Wrestling	Skateboarding	Rope jumping
	Skating, ice, in-line, roller	Running
	Skiing (cross-country, downhill, water)	Sailing
	Snowboarding[e]	Scuba diving
	Softball	Swimming
	Squash	Table tennis
	Ultimate frisbee	Tennis
	Volleyball	Track
	Windsurfing or surfing	Weight lifting

[a]*Participation not recommended by the American Academy of Pediatrics.*
[b]*The American Academy of Pediatrics recommends limiting the amount of body checking allowed for hockey players 15 years and younger to reduce injuries. (1)*
[c]*Dancing has been further classified into ballet, modern, and jazz since the previous statement was published. (2)*
[d]*A race (contest) in which competitors use a map and compass to find their way through unfamiliar territory.*
[e]*Snowboarding has been added since the previous statement was published. (2)*
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should prompt the clinician to obtain neuroimaging studies.

Seizure disorders (epilepsy) typically improve with exercise, and most athletes with seizures should not be excluded from sport participation. However, there are exceptions when having a seizure could endanger the health or safety of the athlete or those around him or her. For example, athletes with epilepsy should not participate in skydiving, scuba diving, or shooting sports such as riflery or archery. Swimming and diving are generally allowable as long as the athlete is constantly supervised during practice and competition.

Stingers or burners are injuries to the brachial plexus and/or cervical nerve roots. If symptoms are brief in duration and the athlete recovers full strength and sensation between injuries, these injuries are generally benign. An athlete should not be returned to play with a symptomatic stinger, and symptoms that last longer than 48 hours generally require

additional evaluation for cervical spine injury. Athletes with frequent recurrent stingers should also be further evaluated to rule out cervical stenosis or other cervical spine abnormalities that might put them at risk for more severe neurologic injury. If an athlete presents with bilateral stingers, he or she should be disqualified from contact sport participation until his or her cervical spine has been fully evaluated.

Transient quadriparesis, also known as cervical spine neuropraxia, is a common and dramatic event that occurs when the cervical spine is concussed. The athlete typically loses most or all motor control of all 4 extremities. It is generally a benign condition as long as the athlete recovers full neurologic function within a few hours of the event. However, these events are so dramatic that it is reasonable to obtain brain and cervical spine neuroimaging to ensure that the athlete has not sustained a more severe injury and that the athlete does not have an underlying cervical spine stenosis or other structural abnormality. Management of the athlete who is symptomatic for more than 24 hours is controversial and should prompt most providers to obtain expert consultation.

MUSCULOSKELETAL

The musculoskeletal history has demonstrated excellent sensitivity for detecting injuries or conditions that may affect sport participation. (22) Inquiring about any injury or complaint that caused the athlete to miss time from their sport or required surgery, casting, bracing, taping, use of crutches, imaging, evaluation by a medical professional, or rehabilitation will identify most musculoskeletal problems that require further evaluation or treatment.

PULMONARY

Exercise-induced bronchospasm affects 12% to 15% of athletes and is more common in athletes with allergic rhinitis and/or allergic asthma. (23) Well-controlled asthma is not a contraindication to sport participation. Most athletes with EIB will benefit from use of a bronchodilator approximately 20 to 30 minutes before exercise. Any athlete with asthma should have an asthma action plan, a metered-dose inhaler on-site for immediate use, and consideration for multiple inhalers (one at home, one at school).

FEMALE ATHLETES

A menstrual history, including menarchal status, age at menarche, and how many periods have occurred in the past 12 months, will help identify athletes at increased risk for female athlete triad (24) (Table 3). The triad is defined as a medical condition often observed in physically active girls and women and involves 3 components (25): low-energy availability with or without disordered eating, menstrual dysfunction, and low bone mineral density.

It is estimated that 16% to 54% of high school female athletes will have 1 component, and that 1.2% will have all 3 components of the triad. (26) Athletes involved in activities that tend to be associated with low body weight (eg, running and ballet dancing) or sports in which scoring is subjective (eg, figure skating and gymnastics) have a higher risk of the triad. A history of stress fracture or restricted dietary intake (eg, a vegan diet) may also indicate an athlete at risk for the triad.

Anemia is associated with heavy or frequent menstrual cycles and nutritional energy deficit. Iron is best obtained through the diet, particularly with the consumption of red meats containing high levels of heme iron. Athletes that follow a strict vegan diet may be at increased risk for iron deficiency due to poor iron bioavailability as well as low iron intake.

PSYCHOLOGICAL

Eating disorders, depression, anxiety, and other psychological or psychiatric conditions commonly affect athletes. Although no psychological condition is an absolute contraindication to sport participation, the provider should consider how these conditions might affect sport participation. Screening for disordered eating should be part of every PPE, and occasionally sport participation will need to be deferred, modified, or closely monitored if the athlete has a life-threatening or poorly controlled eating disorder. Athletes with a history of disordered eating should be monitored by their team's medical personnel (team physician and/or athletic trainer) to ensure continued safe participation during the season. Depression and anxiety can be worsened by the psychological demands of sport participation. However, sport participation is beneficial for most athletes with psychological conditions.

IMMUNIZATION

The PPE is an opportunity to assess immunization status and perform routine or catch-up immunizations. Some athletes travel extensively for their sport, and it may be important to address the need for immunizations or other prophylactic treatment if the athlete intends to travel to areas where preventable illnesses are common. In addition, some athletes commonly share close quarters or have frequent

TABLE 3. **The Female Athlete Triad Coalition's Recommended Screening Questions for the Female Athlete Triad**

QUESTION	INCLUDED ON THE 4TH-EDITION PPE FORM
1. Do you worry about your weight or body composition?	Yes
2. Do you limit or carefully control the foods that you eat?	Yes
3. Do you try to lose weight to meet weight or image/appearance requirements in your sport?	Yes
4. Does your weight affect the way you feel about yourself?	No
5. Do you worry that you have lost control over how much you eat?	No
6. Do you make yourself vomit or use diuretics or laxatives after you eat?	No
7. Do you currently or have you ever suffered from an eating disorder?	Yes
8. Do you ever eat in secret?	
9. What age was your first menstrual period?	Yes
10. Do you have monthly menstrual cycles?	Yes
11. How many menstrual cycles have you had in the last year?	Yes
12. Have you ever had a stress fracture?	Yes

PPE=preparticipation physical evaluation.
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contact with other athletes. For these athletes, it is important to consider immunization for influenza, hepatitis, meningitis, and human papilloma virus.

PHYSICAL EXAMINATION

Vital Signs

Height, weight, and BMI offer data regarding underweight (<5th percentile), overweight (85th–94th percentile), and obesity (≥95th percentile) or possible growth disturbance. However, BMI has substantial limitations as a screening tool in athletes because some athletes with increased lean muscle mass may have a high BMI. Obesity is not a contraindication to sport participation, although it is important to identify athletes who may have complications of their obesity (eg, hypertension, DM, slipped capital femoral epiphysis, etc). Obese patients should be encouraged to exercise safely and may benefit from dietary counseling. Obese athletes commonly gravitate toward sports where size and strength are an advantage (eg, football lineman). However, low-impact aerobic exercise is likely to be more beneficial to the obese athlete who is attempting to lose weight and improve cardiovascular fitness.

Athletes who are extremely thin or underweight may require further evaluation, particularly female athletes who may be at increased risk for the female athlete triad. Underweight is not a contraindication to sport participation, but it does increase risk of injury, especially bony stress injury.

Blood pressure (BP) should be measured after the athlete has been resting for 5 minutes with the arm at heart level using an appropriately sized cuff. Some athletes have very large or very small arms, and using the wrong-sized cuff can make a substantial difference in their BP measurements. Hypertension is the most commonly encountered cardiovascular disease in the athletic population, with 6.4% of athletes presenting for routine PPE found to have an elevated BP. (27) According to The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, (28) "Hypertension is defined as average systolic BP and/or diastolic BP that is ≥95th percentile for gender, age, and height on ≥3 occasions." Although a diagnosis of hypertension should not be made based on an isolated BP reading, the PPE is often the only time a young athlete has their BP taken and is an important step in identifying individuals with hypertension.

The AAP Policy Statement on Athletic Participation by Children and Adolescents Who Have Systemic Hypertension includes the following recommendations (29):

- The presence of prehypertension should not limit a person's eligibility for competitive athletics. Lifestyle modifications, including weight management, daily physical activity, and a well-balanced diet, should be discussed and encouraged. Patients with prehypertension should have their BP measured every 6 months.
- Stage 1 hypertension in the absence of end-organ damage, including left ventricular hypertrophy (LVH) or concomitant heart disease, should not limit a person's eligibility for competitive athletics. These athletes should have their BP rechecked in 1 to 2 weeks to confirm the hypertension or sooner if they are symptomatic. Appropriate referrals to qualified pediatric medical subspecialists need to be made if patients are symptomatic, have LVH or concomitant heart disease, or have persistently elevated BP on 2 additional occasions. Lifestyle modifications should be discussed and encouraged.
- Youth with stage 2 hypertension in the absence of end-organ damage, including LVH or concomitant heart disease, should be restricted from high-static sports that are associated with acute elevation in diastolic pressures (eg, weightlifting, gymnastics) (29) until their BP is in the normal range after lifestyle modification and/or drug therapy. These athletes should be promptly referred and evaluated by a qualified pediatric medical subspecialist within 1 week if they are asymptomatic or immediately if they are symptomatic. Lifestyle modifications should be discussed and encouraged.
- Medication, caffeine, drug, tobacco, and stimulant use should be reviewed with any athlete with hypertension because of the effects that these substances may have on BP.

General

Patients should be screened for stigmata of Marfan syndrome (scoliosis or kyphosis, pectus deformity, increased arm span/height ratio, facial features, thumb sign, wrist sign, myopia, etc). The Marfan Foundation provides an online tool using the revised Ghent criteria to help clinicians diagnose Marfan syndrome.

Head, Eyes, Ears, Nose, and Throat

Visual acuity testing should be performed using a standard Snellen eye chart. Vision should be 20/40 or better in each eye, with or without correction. As previously mentioned, an athlete with best-corrected vision worse than 20/40 in 1 eye is considered to be functionally 1-eyed, and protective eyewear is mandatory in any sport participation. A difference of 2 lines or greater between eyes warrants further evaluation because this may be a sign of amblyopia. Assessment of pupillary size and shape at baseline is helpful, particularly if anisocoria is present as this may be an alarming finding after a concussion that may actually be normal in that patient.

Musculoskeletal

Asymptomatic athletes without a previous injury should undergo a screening musculoskeletal examination (Fig). The musculoskeletal screening examination has limited sensitivity but is sufficient considering the high sensitivity of a musculoskeletal history. This screening examination takes less than 2 minutes to complete.

Any history of injury or symptoms identified on the history portion of the PPE warrant a more detailed examination of that particular body part or joint, and referral for further evaluation or treatment when necessary. Injuries that have not been fully rehabilitated place the athlete at risk for subsequent injury. An athlete must demonstrate pain-free full range of motion, symmetric strength, and stability before clearance to return to participation. Consideration of a protective or supportive device (eg, ankle brace with history of ankle sprain) may allow the athlete to perform at a high level without symptoms or recurrence of injury but should not replace a proper rehabilitation program if deficits are identified on the PPE.

Clinicians may consider adding a joint-specific examination for sports with injury patterns that place specific areas at higher risk. For example, evaluation of the shoulder and elbow in a throwing athlete (eg, baseball, softball) or the knees in a soccer player might identify additional problems but are not required as part of the routine PPE.

Cardiovascular

Cardiac auscultation should be performed in a quiet area to facilitate identification of abnormal heart sounds. The examination is performed in both the supine and standing positions (or with and without Valsalva maneuver) to assess for changes in murmurs of dynamic left ventricular outflow tract obstruction (such as hypertrophic cardiomyopathy). The murmur of hypertrophic cardiomyopathy is typically harsh, early systolic, and heard best at the right upper sternal border. It increases in intensity with activities that decrease cardiac preload, such as standing or Valsalva. Benign cardiac flow

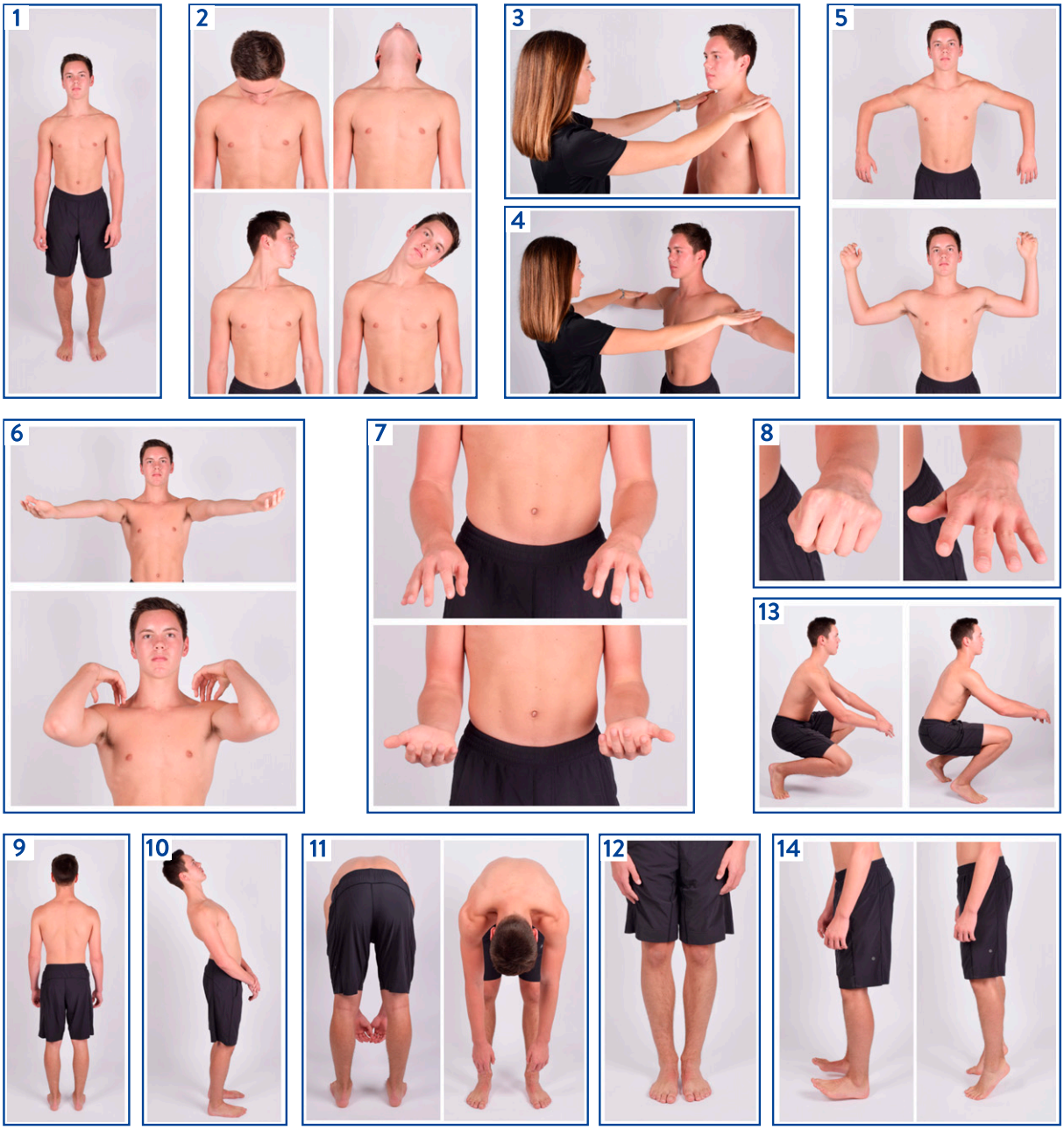

Figure. Musculoskeletal screening examination. The general musculoskeletal screening examination consists of the following: 1) inspection, athlete standing, facing toward examiner (symmetry of trunk, upper extremities); 2) forward flexion, extension, rotation, lateral flexion of neck (range of motion, cervical spine); 3) resisted shoulder shrug (strength, trapezius); 4) resisted shoulder abduction (strength, deltoid); 5) internal and external rotation of shoulder (range of motion, glenohumeral joint); 6) extension and flexion of elbow (range of motion, elbow and wrist); 7) pronation and supination of the elbow (range of motion, elbow and wrist); 8) clench fist, then spread fingers (range of motion, hand and fingers); 9) inspection, athlete facing away from examiner (symmetry of trunk, upper extremities); 10) back extension, knees straight (spondylolysis/spondylolisthesis); 11) back flexion with knees straight, facing toward and away from the examiner (range of motion, thoracic, and lumbosacral spine; spine curvature; hamstring flexibility); 12) inspection of the lower extremities, contraction of quadriceps muscles (alignment, symmetry); 13) "duck walk" 4 steps (motion of hip, knee, and ankle; strength; balance); 14) standing on toes, then on heels (symmetry, calf; strength; balance).

murmurs are common in athletes but typically decrease in intensity with standing or Valsalva.

Palpation of femoral pulses and comparison with radial artery pulses is important to exclude aortic coarctation. A patient with coarctation will typically have diminished intensity of arterial pulse at the femoral artery compared with the radial artery. Rarely, a delay in pulse transmission can be felt in the femoral

arteries. This finding has high specificity for aortic coarctation.

Genitourinary

If performed, a chaperone should be present for any genitourinary examination. Males should be assessed for the presence of 2 descended testicles. The PPE offers an opportunity to educate adolescent males regarding testicular self-examination as a screening tool for early identification of testicular cancer. An undescended testicle carries an increased risk of testicular cancer and warrants referral to urology. Evaluation for inguinal hernias is not required unless there are findings on the history portion that indicate doing so.

A genitourinary examination is not part of the routine PPE in female adolescents unless there is a concerning historical finding or when the PPE also serves as the annual routine health maintenance examination for the female athlete, in which case guidelines for pelvic examination should be followed.

Clearance

Determination of clearance for participation depends on historical and examination findings of the PPE, as well as the activity in which the athlete desires to participate. Most athletes are able to be fully cleared for all sports without restrictions at the time of the PPE. Some athletes will require further evaluation (such as a referral to cardiology for evaluation of a concerning murmur) or treatment (such as a course of rehabilitation to treat an ankle sprain) before full clearance. Additional conditions that may affect sport participation are discussed more fully in the AAP Statement on Medical Conditions Affecting Sport Participation (Appendix B). (20)

Very few athletes (approximately 1%) will not be cleared for sport participation, but disqualification from one sport does not necessarily imply ineligibility for all sports. Any time a patient is restricted from participation, an alternative activity should be recommended. For example, if a patient is restricted from contact sports due to a history of multiple concussions, he or she may still be able to participate in a noncontact sport, such as running track, dance, or tennis.

CONCLUSIONS

Pediatricians should generally feel comfortable managing injury and illness prevention and detecting potentially dangerous medical conditions in athletes and nonathletes alike. The PPE provides some unique challenges and opportunities in a population of children and adolescents who may otherwise rarely seek medical care. These otherwise healthy patients may have no other interaction with a medical professional, so the PPE should be taken seriously by parents, athletes, and medical providers and not treated as just an administrative barrier to sport participation. The PPE Monograph published by the AAP is an excellent resource and offers evidence-based guidelines for pediatricians and other health-care providers.

Summary

- Based primarily on consensus, the preparticipation physical evaluation should be performed by the primary care physician in the patient's medical home.
- Based on some research (4) as well as consensus, cardiovascular screening should include a thorough personal and family history. Routine electrocardiographic screening remains controversial at this time.
- Based on strong research as well as consensus, (30) 60 minutes of daily physical activity is recommended for all children and adolescents and should be encouraged by pediatricians routinely during annual health examinations.

References for this article are at http://pedsinreview.aappublications.org/content/40/3/108.

PIR Quiz

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1. You are seeing a 12-year-old African American boy for a yearly physical and sports preparticipation clearance. You notice that he has sickle cell trait as listed on his problem list diagnosed by newborn screen. The rest of his history and physical examination findings are normal. Which of the following is the most appropriate sport participation clearance recommendation for this patient?
    A. Clear him and recommend adequate breaks, hydration, conditioning, and avoidance of/acclimatization to high altitudes.
    B. Clear him for all sports with no special recommendations because he can be treated the same as a healthy 12-year-old.
    C. Clear him for only low-intensity sports with no special recommendations.
    D. Exclude him from sport participation to prevent sickling, dehydration, and rhabdomyolysis.
    E. Limit his exercise to early morning or late in the day when the temperature is cooler to avoid overheating.
2. A 16-year-old female teenager, known to your practice, presents to the clinic for a sports physical. You saw her last month as a follow-up to an emergency department (ED) visit for fainting episodes. She has had multiple fainting episodes during the past 6 months without any known explanation. The episodes are not related to exertion or physical activity. Review of her ED records shows that she had a normal electrocardiogram (EKG), laboratory studies, and brain computed tomographic scan. A referral to cardiology was made by the ED and is pending at this point. Her appointment is 3 months away. The patient says "nothing is wrong" with her and is keen to start soccer in the fall. Her family is, however, worried. Which of the following is the next best step in management?
    A. Do not clear her for sports until she is cleared by cardiology, and assist the family in expediting the cardiology evaluation.
    B. Clear her for sports today and cancel the cardiology referral since her studies in the ED were normal.
    C. Clear her for soccer practice today but not for competition until her cardiology evaluation is completed.
    D. Clear her for sports today and recommend that she keeps the cardiology appointment in 3 months.
    E. Clear her for sports today and recommend that she keeps the cardiology appointment in 3 months only if she had recurrence of her symptoms.
3. A 14-year-old boy comes to your office for his yearly physical and wants to return to play soccer in the fall. He has had 2 episodes of concussion in the previous season and has returned to baseline. He was referred to a sports medicine specialist the last time you saw him. You note that the sports medicine specialist ordered neurocognitive testing, which has not been done yet. Which of the following is the best recommendation to give the family today regarding neurocognitive testing in this patient?
    A. Can be done at any time during the soccer season and will not hold his sports clearance today.
    B. Is not a sensitive test and, therefore, is not indicated at this time or in the future.
    C. It is not needed at this time because the patient has fully recovered and is asymptomatic.
    D. Should be conducted now as a baseline before the next season.
    E. Should be conducted only if he has another concussion episode in the future.

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2019 *Pediatrics in Review* now is approved for a total of 30 Maintenance of Certification (MOC) Part 2 credits by the American Board of Pediatrics through the AAP MOC Portfolio Program. Complete the first 10 issues or a total of 30 quizzes of journal CME credits, achieve a 60% passing score on each, and start claiming MOC credits as early as October 2019. To learn how to claim MOC points, go to: http://www.aappublications.org/content/moc-credit.

4. A 13-year-old female gymnast is brought to your office for her yearly physical examination and clearance for sports. The mother reports that the patient does not eat much, watches her calories very closely, and obsesses over her weight. Since the last time you saw her, she appears skinny and is less than the 5th percentile for weight. Menarche occurred at 11 years of age. Which of the following additional historical findings is most likely to suggest an increased risk of the female athlete triad in this patient?

    A. Chronic throbbing headaches associated with exercise.
    B. High energy level as evidenced by overexercising.
    C. Hypertension triggered by exercise.
    D. Maintaining a constant body weight across 12 months.
    E. Menstrual dysfunction in the past 12 months, such as irregular menses or amenorrhea.

5. A 13-year-old boy is brought to the clinic for his yearly physical examination. His family history is negative for early cardiac deaths in family members. On physical examination you note a harsh, early systolic murmur best heard over the right upper sternal border that increases in intensity on standing. Pulses are normal and equal in all 4 extremities. Which of the following is the next best step in management in this patient?

    A. Clear him for all sports and order an EKG to be performed in the future at the family's convenience.
    B. Clear him for all sports and reassure the family that this is a benign heart murmur.
    C. Clear him for low-intensity sports, no further evaluation is indicated.
    D. No clearance for sports and follow up on the murmur in 1 year.
    E. No clearance for sports. Reevaluate after an EKG, echocardiogram, and cardiology clearance are completed.

PREPARTICIPATION PHYSICAL EVALUATION
HISTORY FORM

(Note: This form is to be filled out by the patient and parent prior to seeing the physician. The physician should keep this form in the chart.)

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

Medicines and Allergies: Please list all of the prescription and over-the-counter medicines and supplements (herbal and nutritional) that you are currently taking

_____

_____

_____

Do you have any allergies? ☐ Yes ☐ No If yes, please identify specific allergy below.
☐ Medicines ☐ Pollens ☐ Food ☐ Stinging Insects

Explain "Yes" answers below. Circle questions you don't know the answers to.

GENERAL QUESTIONS	Yes	No
1. Has a doctor ever denied or restricted your participation in sports for any reason?		
2. Do you have any ongoing medical conditions? If so, please identify below: ☐ Asthma ☐ Anemia ☐ Diabetes ☐ Infections Other: _____		
3. Have you ever spent the night in the hospital?		
4. Have you ever had surgery?		
HEART HEALTH QUESTIONS ABOUT YOU	**Yes**	**No**
5. Have you ever passed out or nearly passed out DURING or AFTER exercise?		
6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?		
7. Does your heart ever race or skip beats (irregular beats) during exercise?		
8. Has a doctor ever told you that you have any heart problems? If so, check all that apply: ☐ High blood pressure ☐ A heart murmur ☐ High cholesterol ☐ A heart infection ☐ Kawasaki disease Other: _____		
9. Has a doctor ever ordered a test for your heart? (For example, ECG/EKG, echocardiogram)		
10. Do you get lightheaded or feel more short of breath than expected during exercise?		
11. Have you ever had an unexplained seizure?		
12. Do you get more tired or short of breath more quickly than your friends during exercise?		
HEART HEALTH QUESTIONS ABOUT YOUR FAMILY	**Yes**	**No**
13. Has any family member or relative died of heart problems or had an unexpected or unexplained sudden death before age 50 (including drowning, unexplained car accident, or sudden infant death syndrome)?		
14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy, long QT syndrome, short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia?		
15. Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?		
16. Has anyone in your family had unexplained fainting, unexplained seizures, or near drowning?		
BONE AND JOINT QUESTIONS	**Yes**	**No**
17. Have you ever had an injury to a bone, muscle, ligament, or tendon that caused you to miss a practice or a game?		
18. Have you ever had any broken or fractured bones or dislocated joints?		
19. Have you ever had an injury that required x-rays, MRI, CT scan, injections, therapy, a brace, a cast, or crutches?		
20. Have you ever had a stress fracture?		
21. Have you ever been told that you have or have you had an x-ray for neck instability or atlantoaxial instability? (Down syndrome or dwarfism)		
22. Do you regularly use a brace, orthotics, or other assistive device?		
23. Do you have a bone, muscle, or joint injury that bothers you?		
24. Do any of your joints become painful, swollen, feel warm, or look red?		
25. Do you have any history of juvenile arthritis or connective tissue disease?		

MEDICAL QUESTIONS	Yes	No
26. Do you cough, wheeze, or have difficulty breathing during or after exercise?		
27. Have you ever used an inhaler or taken asthma medicine?		
28. Is there anyone in your family who has asthma?		
29. Were you born without or are you missing a kidney, an eye, a testicle (males), your spleen, or any other organ?		
30. Do you have groin pain or a painful bulge or hernia in the groin area?		
31. Have you had infectious mononucleosis (mono) within the last month?		
32. Do you have any rashes, pressure sores, or other skin problems?		
33. Have you had a herpes or MRSA skin infection?		
34. Have you ever had a head injury or concussion?		
35. Have you ever had a hit or blow to the head that caused confusion, prolonged headache, or memory problems?		
36. Do you have a history of seizure disorder?		
37. Do you have headaches with exercise?		
38. Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling?		
39. Have you ever been unable to move your arms or legs after being hit or falling?		
40. Have you ever become ill while exercising in the heat?		
41. Do you get frequent muscle cramps when exercising?		
42. Do you or someone in your family have sickle cell trait or disease?		
43. Have you had any problems with your eyes or vision?		
44. Have you had any eye injuries?		
45. Do you wear glasses or contact lenses?		
46. Do you wear protective eyewear, such as goggles or a face shield?		
47. Do you worry about your weight?		
48. Are you trying to or has anyone recommended that you gain or lose weight?		
49. Are you on a special diet or do you avoid certain types of foods?		
50. Have you ever had an eating disorder?		
51. Do you have any concerns that you would like to discuss with a doctor?		
FEMALES ONLY		
52. Have you ever had a menstrual period?		
53. How old were you when you had your first menstrual period?		
54. How many periods have you had in the last 12 months?		

Explain "yes" answers here

_____

_____

_____

_____

_____

_____

_____

_____

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of athlete _____ Signature of parent/guardian _____ Date _____

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Appendix A. Preparticipation Physical Evaluation Physical Examination Form. (Reprinted with permission from Bernhardt DT, Roberts WO; American Academy of Family Physicians, American Academy of Pediatrics. *PPE: Preparticipation Physical Evaluation*. 4th ed. Elk Grove Village: American Academy of Pediatrics; 2010.

Preparticipation Physical Evaluation

THE ATHLETE WITH SPECIAL NEEDS: SUPPLEMENTAL HISTORY FORM

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

1. Type of disability	
2. Date of disability	
3. Classification (if available)	
4. Cause of disability (birth, disease, accident/trauma, other)	
5. List the sports you are interested in playing	

	Yes	No
6. Do you regularly use a brace, assistive device, or prosthetic?		
7. Do you use any special brace or assistive device for sports?		
8. Do you have any rashes, pressure sores, or any other skin problems?		
9. Do you have a hearing loss? Do you use a hearing aid?		
10. Do you have a visual impairment?		
11. Do you use any special devices for bowel or bladder function?		
12. Do you have burning or discomfort when urinating?		
13. Have you had autonomic dysreflexia?		
14. Have you ever been diagnosed with a heat-related (hyperthermia) or cold-related (hypothermia) illness?		
15. Do you have muscle spasticity?		
16. Do you have frequent seizures that cannot be controlled by medication?		

Explain "yes" answers here

Please indicate if you have ever had any of the following.

	Yes	No
Atlantoaxial instability		
X-ray evaluation for atlantoaxial instability		
Dislocated joints (more than one)		
Easy bleeding		
Enlarged spleen		
Hepatitis		
Osteopenia or osteoporosis		
Difficulty controlling bowel		
Difficulty controlling bladder		
Numbness or tingling in arms or hands		
Numbness or tingling in legs or feet		
Weakness in arms or hands		
Weakness in legs or feet		
Recent change in coordination		
Recent change in ability to walk		
Spina bifida		
Latex allergy		

Explain "yes" answers here

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of athlete _____ Signature of parent/guardian _____ Date _____

Appendix A. (Continued.)

PREPARTICIPATION PHYSICAL EVALUATION
PHYSICAL EXAMINATION FORM

Name _____ Date of birth _____

PHYSICIAN REMINDERS

1. Consider additional questions on more sensitive issues
   - Do you feel stressed out or under a lot of pressure?
   - Do you ever feel sad, hopeless, depressed, or anxious?
   - Do you feel safe at your home or residence?
   - Have you ever tried cigarettes, chewing tobacco, snuff, or dip?
   - During the past 30 days, did you use chewing tobacco, snuff, or dip?
   - Do you drink alcohol or use any other drugs?
   - Have you ever taken anabolic steroids or used any other performance supplement?
   - Have you ever taken any supplements to help you gain or lose weight or improve your performance?
   - Do you wear a seat belt, use a helmet, and use condoms?
2. Consider reviewing questions on cardiovascular symptoms (questions 5–14).

EXAMINATION		
Height Weight ☐ Male ☐ Female		
BP / (/) Pulse Vision R 20/ L 20/ Corrected ☐ Y ☐ N		
MEDICAL	**NORMAL**	**ABNORMAL FINDINGS**
Appearance • Marfan stigmata (kyphoscoliosis, high-arched palate, pectus excavatum, arachnodactyly, arm span > height, hyperlaxity, myopia, MVP, aortic insufficiency)		
Eyes/ears/nose/throat • Pupils equal • Hearing		
Lymph nodes		
Heart[a] • Murmurs (auscultation standing, supine, +/- Valsalva) • Location of point of maximal impulse (PMI)		
Pulses • Simultaneous femoral and radial pulses		
Lungs		
Abdomen		
Genitourinary (males only)[b]		
Skin • HSV, lesions suggestive of MRSA, tinea corporis		
Neurologic[c]		
MUSCULOSKELETAL		
Neck		
Back		
Shoulder/arm		
Elbow/forearm		
Wrist/hand/fingers		
Hip/thigh		
Knee		
Leg/ankle		
Foot/toes		
Functional • Duck-walk, single leg hop		

[a]Consider ECG, echocardiogram, and referral to cardiology for abnormal cardiac history or exam.
[b]Consider GU exam if in private setting. Having third party present is recommended.
[c]Consider cognitive evaluation or baseline neuropsychiatric testing if a history of significant concussion.

☐ Cleared for all sports without restriction

☐ Cleared for all sports without restriction with recommendations for further evaluation or treatment for _____

_____

☐ Not cleared

- ☐ Pending further evaluation
- ☐ For any sports
- ☐ For certain sports _____

Reason _____

Recommendations _____

_____

I have examined the above-named student and completed the preparticipation physical evaluation. The athlete does not present apparent clinical contraindications to practice and participate in the sport(s) as outlined above. A copy of the physical exam is on record in my office and can be made available to the school at the request of the parents. If conditions arise after the athlete has been cleared for participation, the physician may rescind the clearance until the problem is resolved and the potential consequences are completely explained to the athlete (and parents/guardians).

Name of physician (print/type) _____ Date _____

Address _____ Phone _____

Signature of physician _____, MD or DO

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Appendix A. (Continued.)

PREPARTICIPATION PHYSICAL EVALUATION
CLEARANCE FORM

Name _____ Sex ☐ M ☐ F Age _____ Date of birth _____

☐ Cleared for all sports without restriction

☐ Cleared for all sports without restriction with recommendations for further evaluation or treatment for _____

_____

☐ Not cleared

- ☐ Pending further evaluation
- ☐ For any sports
- ☐ For certain sports _____

Reason _____

Recommendations _____

_____

_____

_____

_____

_____

I have examined the above-named student and completed the preparticipation physical evaluation. The athlete does not present apparent clinical contraindications to practice and participate in the sport(s) as outlined above. A copy of the physical exam is on record in my office and can be made available to the school at the request of the parents. If conditions arise after the athlete has been cleared for participation, the physician may rescind the clearance until the problem is resolved and the potential consequences are completely explained to the athlete (and parents/guardians).

Name of physician (print/type) _____ Date _____

Address _____ Phone _____

Signature of physician _____, MD or DO

EMERGENCY INFORMATION

Allergies _____

_____

_____

_____

_____

_____

Other information _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix A. (Continued.)

Condition	May Participate
Atlantoaxial instability (instability of the joint between cervical vertebrae 1 and 2)	Qualified yes
Explanation: Athlete (particularly if he or she has Down syndrome or juvenile rheumatoid arthritis with cervical involvement) needs evaluation to assess the risk of spinal cord injury during sports participation, especially when using a trampoline.[4–7]	
Bleeding disorder	Qualified yes
Explanation: Athlete needs evaluation.[8,9]	
Cardiovascular disease	
Carditis (inflammation of the heart)	No
Explanation: Carditis may result in sudden death with exertion.	
Hypertension (high blood pressure)	Qualified yes
Explanation: Those with hypertension >5 mm Hg above the 99th percentile for age, gender, and height should avoid heavy weightlifting and power lifting, bodybuilding, and high-static component sports (Fig 1). Those with sustained hypertension (>95th percentile for age, gender, and height) need evaluation.[10–12] The National High Blood Pressure Education Program Working Group report defined prehypertension and stage 1 and stage 2 hypertension in children and adolescents younger than 18 years of age.[10]	
Congenital heart disease (structural heart defects present at birth)	Qualified yes
Explanation: Consultation with a cardiologist is recommended. Those who have mild forms may participate fully in most cases; those who have moderate or severe forms or who have undergone surgery need evaluation. The 36th Bethesda Conference[12] defined mild, moderate, and severe disease for common cardiac lesions.	
Dysrhythmia (irregular heart rhythm)	Qualified yes
Long-QT syndrome	
Malignant ventricular arrhythmias	
Symptomatic Wolff-Parkinson-White syndrome	
Advanced heart block	
Family history of sudden death or previous sudden cardiac event	
Implantation of a cardioverter-defibrillator	
Explanation: Consultation with a cardiologist is advised. Those with symptoms (chest pain, syncope, near-syncope, dizziness, shortness of breath, or other symptoms of possible dysrhythmia) or evidence of mitral regurgitation on physical examination need evaluation. All others may participate fully.[13–15]	
Heart murmur	Qualified yes
Explanation: If the murmur is innocent (does not indicate heart disease), full participation is permitted. Otherwise, athlete needs evaluation (see structural heart disease, especially hypertrophic cardiomyopathy and mitral valve prolapse).	
Structural/acquired heart disease	
Hypertrophic cardiomyopathy	Qualified no
Coronary artery anomalies	Qualified no
Arrhythmogenic right ventricular cardiomyopathy	Qualified no
Acute rheumatic fever with carditis	Qualified no
Ehlers-Danlos syndrome, vascular form	Qualified no
Marfan syndrome	Qualified yes
Mitral valve prolapse	Qualified yes
Anthracycline use	Qualified yes
Explanation: Consultation with a cardiologist is recommended. The 36th Bethesda Conference provided detailed recommendations.[12,13,15–18] Most of these conditions carry a significant risk of sudden cardiac death associated with intense physical exercise. Hypertrophic cardiomyopathy requires thorough and repeated evaluations, because disease may change manifestations during later adolescence.[12,13,17] Marfan syndrome with an aortic aneurysm also can cause sudden death during intense physical exercise.[18] Athlete who has ever received chemotherapy with anthracyclines may be at increased risk of cardiac problems because of the cardiotoxic effects of the medications, and resistance training in this population should be approached with caution; strength training that avoids isometric contractions may be permitted.[19,20] Athlete needs evaluation.	
Vasculitis/vascular disease	Qualified yes
Kawasaki disease (coronary artery vasculitis)	
Pulmonary hypertension	
Explanation: Consultation with a cardiologist is recommended. Athlete needs individual evaluation to assess risk on the basis of disease activity, pathologic changes, and medical regimen.[21]	
Cerebral palsy	Qualified yes
Explanation: Athlete needs evaluation to assess functional capacity to perform sports-specific activity.	
Diabetes mellitus	Yes
Explanation: All sports can be played with proper attention and appropriate adjustments to diet (particularly carbohydrate intake), blood glucose concentrations, hydration, and insulin therapy. Blood glucose concentrations should be monitored before exercise, every 30 min during continuous exercise, 15 min after completion of exercise, and at bedtime.	
Diarrhea, infectious	Qualified no
Explanation: Unless symptoms are mild and athlete is fully hydrated, no participation is permitted, because diarrhea may increase risk of dehydration and heat illness (see fever).	
Eating disorders	Qualified yes
Explanation: Athlete with an eating disorder needs medical and psychiatric assessment before participation.	
Eyes	Qualified yes
Functionally 1-eyed athlete	
Loss of an eye	
Detached retina or family history of retinal detachment at young age	
High myopia	
Connective tissue disorder, such as Marfan or Stickler syndrome	
Previous intraocular eye surgery or serious eye injury	

Appendix B. Medical Conditions Affecting Sports Participation. (Reprinted with permission from Rice SG; American Academy of Pediatrics Council on Sports Medicine and Fitness. Medical conditions affecting sports participation. *Pediatrics*. 2008;121(4):841–848.)

Condition	May Participate
Explanation: A functionally 1-eyed athlete is defined as having best-corrected visual acuity worse than 20/40 in the poorer-seeing eye. Such an athlete would suffer significant disability if the better eye were seriously injured, as would an athlete with loss of an eye. Specifically, boxing and full-contact martial arts are not recommended for functionally 1-eyed athletes, because eye protection is impractical and/or not permitted. Some athletes who previously underwent intraocular eye surgery or had a serious eye injury may have increased risk of injury because of weakened eye tissue. Availability of eye guards approved by the American Society for Testing and Materials and other protective equipment may allow participation in most sports, but this must be judged on an individual basis.[22,23]	
Conjunctivitis, infectious	Qualified no
Explanation: Athlete with active infectious conjunctivitis should be excluded from swimming.	
Fever	No
Explanation: Elevated core temperature may be indicative of a pathologic medical condition (infection or disease) that is often manifest by increased resting metabolism and heart rate. Accordingly, during athlete's usual exercise regimen, the presence of fever can result in greater heat storage, decreased heat tolerance, increased risk of heat illness, increased cardiopulmonary effort, reduced maximal exercise capacity, and increased risk of hypotension because of altered vascular tone and dehydration. On rare occasions, fever may accompany myocarditis or other conditions that may make usual exercise dangerous.	
Gastrointestinal	Qualified yes
Malabsorption syndromes (celiac disease or cystic fibrosis)	
Explanation: Athlete needs individual assessment for general malnutrition or specific deficits resulting in coagulation or other defects; with appropriate treatment, these deficits can be treated adequately to permit normal activities.	
Short-bowel syndrome or other disorders requiring specialized nutritional support, including parenteral or enteral nutrition	
Explanation: Athlete needs individual assessment for collision, contact, or limited-contact sports. Presence of central or peripheral, indwelling, venous catheter may require special considerations for activities and emergency preparedness for unexpected trauma to the device(s).	
Heat illness, history of	Qualified yes
Explanation: Because of the likelihood of recurrence, athlete needs individual assessment to determine the presence of predisposing conditions and behaviors and to develop a prevention strategy that includes sufficient acclimatization (to the environment and to exercise intensity and duration), conditioning, hydration, and salt intake, as well as other effective measures to improve heat tolerance and to reduce heat injury risk (such as protective equipment and uniform configurations).[24,25]	
Hepatitis, infectious (primarily hepatitis C)	Yes
Explanation: All athletes should receive hepatitis B vaccination before participation. Because of the apparent minimal risk to others, all sports may be played as athlete's state of health allows. For all athletes, skin lesions should be covered properly, and athletic personnel should use universal precautions when handling blood or body fluids with visible blood.[26]	
HIV infection	Yes
Explanation: Because of the apparent minimal risk to others, all sports may be played as athlete's state of health allows (especially if viral load is undetectable or very low). For all athletes, skin lesions should be covered properly, and athletic personnel should use universal precautions when handling blood or body fluids with visible blood.[26] However, certain sports (such as wrestling and boxing) may create a situation that favors viral transmission (likely bleeding plus skin breaks). If viral load is detectable, then athletes should be advised to avoid such high-contact sports.	
Kidney, absence of one	Qualified yes
Explanation: Athlete needs individual assessment for contact, collision, and limited-contact sports. Protective equipment may reduce risk of injury to the remaining kidney sufficiently to allow participation in most sports, providing such equipment remains in place during activity.[22]	
Liver, enlarged	Qualified yes
Explanation: If the liver is acutely enlarged, then participation should be avoided because of risk of rupture. If the liver is chronically enlarged, then individual assessment is needed before collision, contact, or limited-contact sports are played. Patients with chronic liver disease may have changes in liver function that affect stamina, mental status, coagulation, or nutritional status.	
Malignant neoplasm	Qualified yes
Explanation: Athlete needs individual assessment.[27]	
Musculoskeletal disorders	Qualified yes
Explanation: Athlete needs individual assessment.	
Neurologic disorders	
History of serious head or spine trauma or abnormality, including craniotomy, epidural bleeding, subdural hematoma, intracerebral hemorrhage, second-impact syndrome, vascular malformation, and neck fracture.[4,5,28–30]	Qualified yes
Explanation: Athlete needs individual assessment for collision, contact, or limited-contact sports.	
History of simple concussion (mild traumatic brain injury), multiple simple concussions, and/or complex concussion	Qualified yes
Explanation: Athlete needs individual assessment. Research supports a conservative approach to concussion management, including no athletic participation while symptomatic or when deficits in judgment or cognition are detected, followed by graduated return to full activity.[28–32]	
Myopathies	Qualified yes
Explanation: Athlete needs individual assessment.	
Recurrent headaches	Yes
Explanation: Athlete needs individual assessment.[33]	
Recurrent plexopathy (burner or stinger) and cervical cord neuropraxia with persistent defects	Qualified yes
Explanation: Athlete needs individual assessment for collision, contact, or limited-contact sports; regaining normal strength is important benchmark for return to play.[34,35]	
Seizure disorder, well controlled	Yes
Explanation: Risk of seizure during participation is minimal.[36]	
Seizure disorder, poorly controlled	Qualified yes
Explanation: Athlete needs individual assessment for collision, contact, or limited-contact sports. The following noncontact sports should be avoided: archery, riflery, swimming, weightlifting, power lifting, strength training, and sports involving heights. In these sports, occurrence of a seizure during activity may pose a risk to self or others.[36]	

Appendix B. (Continued.)

Condition	May Participate
Obesity	Yes
Explanation: Because of the increased risk of heat illness and cardiovascular strain, obese athlete particularly needs careful acclimatization (to the environment and to exercise intensity and duration), sufficient hydration, and potential activity and recovery modifications during competition and training.[37]	
Organ transplant recipient (and those taking immunosuppressive medications)	Qualified yes
Explanation: Athlete needs individual assessment for contact, collision, and limited-contact sports. In addition to potential risk of infections, some medications (eg, prednisone) may increase tendency for bruising.	
Ovary, absence of one	Yes
Explanation: Risk of severe injury to remaining ovary is minimal.	
Pregnancy/postpartum	Qualified yes
Explanation: Athlete needs individual assessment. As pregnancy progresses, modifications to usual exercise routines will become necessary. Activities with high risk of falling or abdominal trauma should be avoided. Scuba diving and activities posing risk of altitude sickness should also be avoided during pregnancy. After the birth, physiological and morphologic changes of pregnancy take 4 to 6 weeks to return to baseline.[38,39]	
Respiratory conditions	
Pulmonary compromise, including cystic fibrosis	Qualified yes
Explanation: Athlete needs individual assessment but, generally, all sports may be played if oxygenation remains satisfactory during graded exercise test. Athletes with cystic fibrosis need acclimatization and good hydration to reduce risk of heat illness.	
Asthma	Yes
Explanation: With proper medication and education, only athletes with severe asthma need to modify their participation. For those using inhalers, recommend having a written action plan and using a peak flowmeter daily.[40–43] Athletes with asthma may encounter risks when scuba diving.	
Acute upper respiratory infection	Qualified yes
Explanation: Upper respiratory obstruction may affect pulmonary function. Athlete needs individual assessment for all except mild disease (see fever).	
Rheumatologic diseases	Qualified yes
Juvenile rheumatoid arthritis	
Explanation: Athletes with systemic or polyarticular juvenile rheumatoid arthritis and history of cervical spine involvement need radiographs of vertebrae C1 and C2 to assess risk of spinal cord injury. Athletes with systemic or HLA-B27-associated arthritis require cardiovascular assessment for possible cardiac complications during exercise. For those with micrognathia (open bite and exposed teeth), mouth guards are helpful. If uveitis is present, risk of eye damage from trauma is increased; ophthalmologic assessment is recommended. If visually impaired, guidelines for functionally 1-eyed athletes should be followed.[44]	
Juvenile dermatomyositis, idiopathic myositis	
Systemic lupus erythematosis	
Raynaud phenomenon	
Explanation: Athlete with juvenile dermatomyositis or systemic lupus erythematosis with cardiac involvement requires cardiology assessment before participation. Athletes receiving systemic corticosteroid therapy are at higher risk of osteoporotic fractures and avascular necrosis, which should be assessed before clearance; those receiving immunosuppressive medications are at higher risk of serious infection. Sports activities should be avoided when myositis is active. Rhabdomyolysis during intensive exercise may cause renal injury in athletes with idiopathic myositis and other myopathies. Because of photosensitivity with juvenile dermatomyositis and systemic lupus erythematosis, sun protection is necessary during outdoor activities. With Raynaud phenomenon, exposure to the cold presents risk to hands and feet.[45–48]	
Sickle cell disease	Qualified yes
Explanation: Athlete needs individual assessment. In general, if illness status permits, all sports may be played; however, any sport or activity that entails overexertion, overheating, dehydration, or chilling should be avoided. Participation at high altitude, especially when not acclimatized, also poses risk of sickle cell crisis.	
Sickle cell trait	Yes
Explanation: Athletes with sickle cell trait generally do not have increased risk of sudden death or other medical problems during athletic participation under normal environmental conditions. However, when high exertional activity is performed under extreme conditions of heat and humidity or increased altitude, such catastrophic complications have occurred rarely.[8,49–52] Athletes with sickle cell trait, like all athletes, should be progressively acclimatized to the environment and to the intensity and duration of activities and should be sufficiently hydrated to reduce the risk of exertional heat illness and/or rhabdomyolysis.[25] According to National Institutes of Health management guidelines, sickle cell trait is not a contraindication to participation in competitive athletics, and there is no requirement for screening before participation.[53] More research is needed to assess fully potential risks and benefits of screening athletes for sickle cell trait.	
Skin infections, including herpes simplex, molluscum contagiosum, verrucae (warts), staphylococcal and streptococcal infections (furuncles [boils], carbuncles, impetigo, methicillin-resistant *Staphylococcus aureus* [cellulitis and/or abscesses]), scabies, and tinea	Qualified yes
Explanation: During contagious periods, participation in gymnastics or cheerleading with mats, martial arts, wrestling, or other collision, contact, or limited-contact sports is not allowed.[54–57]	
Spleen, enlarged	Qualified yes
Explanation: If the spleen is acutely enlarged, then participation should be avoided because of risk of rupture. If the spleen is chronically enlarged, then individual assessment is needed before collision, contact, or limited-contact sports are played.	
Testicle, undescended or absence of one	Yes
Explanation: Certain sports may require a protective cup.[22]	

This table is designed for use by medical and nonmedical personnel. "Needs evaluation" means that a physician with appropriate knowledge and experience should assess the safety of a given sport for an athlete with the listed medical condition. Unless otherwise noted, this need for special consideration is because of variability in the severity of the disease, the risk of injury for the specific sports listed in Table 1, or both.

Appendix B. (Continued.)