

Praeger Handbook of

# SPORTS MEDICINE

AND

# ATHLETE HEALTH

Volume Two

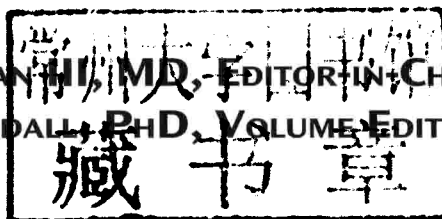
## ATHLETE HEALTH, INJURIES, AND PREVENTION

Claude T. Moorman III, MD, Editor-in-Chief and Donald T. Kirkendall, PhD, Volume Editor

# **Praeger Handbook of Sports Medicine and Athlete Health**

**Volume 2**  
**Athlete Health, Injuries, and Prevention**

**CLAUDE T. MOORMAN III, MD, EDITOR IN CHIEF**  
**DONALD T. KIRKENDALL, PhD, VOLUME EDITOR**



**PRAEGER**

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# Preface

***Claude T. Moorman III  
and Donald T. Kirkendall***

Sports participation is inherently risky. Every time one goes out for some recreational activity, to train, or to compete, there are elements of risk—the risk of winning, of losing, of success, of embarrassment and, for the purposes of this book, the risk of an injury.

Athletic training and competition has become a laboratory for orthopedics and rehabilitation. Much like motor racing has hastened developments in the automobile industry, sports injury has accelerated advances in orthopedics and sports medicine. Why? The injured athlete wants to return to play—NOW! This may be quite the opposite of workplace injuries, where the injured employee might be looking for an extended period of paid time out of work.

Athletes are very eager patients. They usually are not happy unless they are active, so the sports medicine profession works very hard at trying to get players back on the field as quickly and as safely as possible. It used to be that an ACL tear was a career-ending injury. Then it was an injury that a player might recover from in 12 to 18 months, but might take another year before returning to their pre-injury level of competition. Advances in sports medicine have shortened the time lost off the field now to around 6 months, and there are reports of some players returning to competition in even less time.

One important factor in the recovery from injury is an informed patient. Physicians want their patients to know what was hurt, how

the injury happened, what the options for treatment and prevention are, how long they will be sidelined, and what the chances are of returning to their previous level of play. The passive patient on matters like these could well be a patient that has a poor chance of returning to the highest level of his or her sport possible.

Our purpose is to try to demystify sports injury. Great pains were taken to make complex anatomy, physiology, biomechanics, treatment, surgery, and rehabilitation accessible to the public—our patients and readers. Many patients are intimidated by the medical jargon used by physicians. By shifting away from scary jargon to language understandable by the typical patient or the patient's parents, we are hopeful that everyone concerned will be better informed, more capable of asking important questions about their care, and ultimately more likely to return to whatever level of sport they wish. An informed, knowledgeable patient is a better patient, and a patient who is most likely to enjoy activity long after a sports injury.

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## **Chapter 1**

# **The Pre-Participation Physical Examination**

***Margot Putukian and Jason Womack***

The pre-participation physical exam (PPE) is a useful tool geared toward providing safe participation in sports. Athletic activity places stress on the body that expose athletes to a myriad of injuries and medical complications. The PPE is a screening tool that has three major goals: (1) screen for conditions that may be life threatening or disabling, (2) screen for conditions that may predispose the athlete to injury or illness, and (3) meet various administrative or regulatory requirements. In addition, the PPE is an opportunity to assess general health and, for many younger athletes, is often the only opportunity to discuss health-related topics such as substance use, sexuality, nutrition, and safety.

The administration of the PPE can occur in a number of different settings. Either an individual physician or team of health care professionals commonly performs the PPE. Each method has its own advantages and disadvantages. In the individual scenario, one health care provider reviews the history, performs the exam, and makes recommendations for further evaluation or clearance. This allows for one-on-one interaction between physician and athlete, helping to develop a rapport to discuss high-risk behaviors such as substance abuse. This method is time consuming, however, and may be difficult to complete the large number of exams needed. The other common setting for performing a PPE is the “station-based” team approach. A different health care



professional performs each part of the PPE on the athletes rotating through each station. For example, separate individuals may be responsible for reviewing the history, doing the medical exam, doing the musculoskeletal exam, and determining clearance for the group of athletes. The advantage of this approach is that a larger number of physicals can be performed at one time, making a station-based approach very time and cost efficient. The disadvantage is that the athlete does not have an opportunity to develop a relationship with one provider, and thus asking questions about high-risk behavior is more difficult.

The PPE is comprised of two major portions; the medical history and the physical examination. The medical history identifies patterns or occurrences that are suggestive of an underlying medical problem. A complete history can identify approximately 75 percent of problems affecting athletes.<sup>3</sup> The second portion of the PPE is the physical exam. A comprehensive examination is performed in an effort to identify any signs of problems that may place the athlete at risk of injury or illness during activity. Particular attention is placed on the cardiovascular, nervous, and musculoskeletal systems. Certain aspects of the PPE may be more focused than others, depending on the individual sport and the particular risks the sport presents.

Many national organizations recognize the PPE as a useful screening tool for athletes prior to participation. The National Federation of State High School Associations considers the PPE a prerequisite to sports participation,<sup>10</sup> and all states, except for Rhode Island, require a PPE. The National Collegiate Athletic Association (NCAA) requires that all athletes receive a PPE prior to participating in their sport, as well as a yearly update.<sup>2</sup> In addition to these recommendations, many institutions have specific individual requirements for a PPE prior to athletic participation.

While the PPE does lead to a certain number of athletes being disqualified from participation in sports, the primary goal continues to be providing safe and optimal athletic performance. The American Academy of Pediatrics has published recommendations regarding clearance for sports participation in relation to specific medical conditions.<sup>9</sup> Complete disqualification is a rare occurrence, representing about 1 percent of all athletes screened, with another 6 to 7 percent requiring additional investigation prior to being approved for sports participation.<sup>3</sup> Further testing or consultation by a medical specialist may be required. Additional testing looks for signs of underlying medical conditions that may affect sports participation. For example, hypertension is one of the most common conditions requiring further evaluation. Blood tests,

electrocardiograms, and urine analyses may be performed to see if a reversible form of high blood pressure exists and to screen for any end organ involvement. After review by a specialist, the majority of athletes will be cleared, with or without certain restrictions.

The yearly pre-participation exam is a prime opportunity to screen athletes for potentially life-threatening conditions. The demands of sports place particular demands on the body that place athletes at greater risks than the general population. Certain signs and symptoms experienced by the athlete can alert health care professionals to investigate further for potentially life-threatening disease or to institute preventive measures to allow safe participation. The PPE is the first line in providing a safe sports environment for athletes, trainers, coaches, and all those involved in organized sports.

Timing of the PPE is important to provide time for further evaluation, if needed. Ideally, a PPE should be performed 6 to 8 weeks prior to start of the sport's season. This allows for the scheduling of consults and testing needed to ensure safe sport participation. You can read more on many of the conditions described here in other chapters in this book.

## **THE MEDICAL HISTORY**

The medical history is a fundamental portion of the pre-participation physical exam. It is meant to be thorough, providing a detailed account of an athlete's present and past medical conditions. The questions are organized to cover the variety of organ systems that are commonly involved in athletic activity. Particular attention is placed on the cardiovascular, pulmonary, nervous, and musculoskeletal systems due to their common involvement in sports.

A detailed past medical history is the physician's opportunity to determine any chronic conditions the athlete may possess and any medications the athlete may take to determine if further measures are necessary to ensure safe participation. For example, an insulin-dependent diabetic may need special instructions on adjusting their insulin in order to account for the decreased insulin requirement during activity. All medications, prescription or over-the-counter, should be reviewed. Certain medications can create physiologic changes in the body that are important to recognize when one is exposed to the rigors of intense exercise. A history of sports restriction represents a potential problem, and it is important to decide whether the reason for that restriction has resolved or needs further evaluation.

The details of prior restriction may provide insight toward necessary preventive measures to avoid similar injury or disability. In addition to medical history, details of any prior surgical procedure must be documented. The type and timing of the surgery can alter an athlete's participation. Orthopedic surgery requires proper recovery and rehabilitation, or the athlete may be placed at risk for a new injury or making a prior injury worse. Lastly, an allergy history should be obtained. Recognition of environmental and medication allergies allows medical personnel to be prepared with the proper medication in the event of a severe allergic reaction. With the foundation of the athlete's past history, the remainder of the history hones in on the particular organ systems and symptoms.

Sudden cardiac death is the most common causes of on-field death, occurring at a rate of about 1 death in every 200,000 athletes.<sup>4</sup> Screening for underlying cardiac disease is a prime goal of the PPE. The American Heart Association has established guidelines for the appropriate elements needed to adequately screen an athlete for cardiac death. There are 12 total elements to be evaluated, 8 of which are related to the history (Table 1.1).<sup>4</sup> While a number of cardiac conditions may be asymptomatic, exposure to highly intense physical activity has been linked to arrhythmia-based sudden death in athletes with underlying cardiac abnormalities. Cardiovascular screening questions provide clues to potentially underlying conditions that need further evaluation. Unexplained chest pain, dizziness, and syncope (fainting), especially if exertional, are ominous symptoms that suggest the possibility of underlying cardiac anomalies that may place the athlete at risk for sudden cardiac death. When these symptoms are present, further investigations, such as electrocardiogram and echocardiogram, are often needed. Participation should be restricted until further testing is obtained. Family history of early cardiac disease or sudden, unexplained death in a first-degree relative under the age of 50 may suggest genetic predisposition to underlying cardiac disease. Identification of underlying cardiac disease and implementation of prevention strategies for sudden cardiac death starts with the PPE.

Asthma is a prevalent disease, and identifying its presence and severity in an athlete can help to prevent exacerbation of symptoms and optimize performance (see chapter 12 for more on asthma). There is a subset of people in whom asthma is associated with strenuous activity. This exercise-induced asthma (EIA) may go undiagnosed for many years and can adversely affect the athlete's performance. The history portion of the PPE includes questions about symptoms of

**Table 1.1**  
**AHA Recommendations for Pre-Participation Cardiovascular Screening in Athletes**

---

Personal History

1. Exertional chest pain/discomfort
2. Unexplained syncope/presyncope\*
3. Excessive exertional and unexplained dyspnea/fatigue, associated with exercise
4. Prior recognition of a heart murmur
5. Elevated systemic blood pressure

Family History

6. Premature death (sudden and unexpected) before age 50 years due to heart disease, in  $\geq 1$  relative
7. Disability from heart disease in a close relative  $\leq 50$  years of age
8. Specific knowledge of cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long QT syndrome or ion channelopathies, Marfan syndrome, or clinically important arrhythmias

Physical Examination

9. Heart murmur
  10. Femoral pulses to exclude aortic coarctation
  11. Physical stigmata of Marfan syndrome
  12. Brachial artery blood pressure (sitting position)
- 

\* Judged not to be neurocardiogenic (vasovagal); of particular concern when related to exertion.

wheezing or coughing during or after activity. If the history is suggestive of exercise-induced asthma, formal testing should be performed to confirm the presence of airway obstruction that can be relieved with bronchodilator treatment. Using a short-acting bronchodilator, such as albuterol, prior to exercise can help athletes with EIA from having symptoms during activity. Athletes who are already being treated for asthma also need to be evaluated, as it may be appropriate to add to or modify the existing asthma treatment in order to minimize symptoms and optimize performance.

Neurologic injury in sport can take many forms. Neurological history focuses on identifying common injuries such as concussion, stingers, and seizure disorders. Sports concussion is defined as a complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces.<sup>6</sup> Concussion is considered a functional, not a structural, brain deficit. There is no associated anatomic disturbance, such as a hemorrhage, that can be seen on any type of modern imaging techniques. Both the timing and severity of prior concussions

should be documented. Those with a history of severe concussion or multiple concussions may have signs or symptoms of post-concussive syndrome. Post-concussive syndrome is a persistence of symptoms such as memory impairment, difficulties in concentration, and emotional disturbances, which normally are transient after the acute injury. The timing of a prior concussion is also important, and athletes should not be cleared back to activity until all symptoms have cleared. Returning to sport prior to complete resolution of all symptoms increases the risk of worsening symptoms and post-concussive syndrome. A rare, but catastrophic, sequel of returning to activity prior to concussion resolution is the so-called Second Impact Syndrome (more correctly termed “diffuse cerebral swelling” that occurs mostly in children and adolescents). Most often, this rare condition is caused by a second, often lesser, head injury prior to full recovery from a primary concussion causing rapid cerebral swelling, leading to brain herniation and death. This is why it is so important to recognize that a concussive injury has occurred so that the athlete can be restricted from activity while the brain is still vulnerable. While rare, the potential for serious consequences underscores the importance of proper concussion management. This syndrome is most often identified after a recent prior injury, but it can occur on the initial injury.

Headache often accompanies concussion, but the athlete’s prior headache patterns are important to clarify. A baseline understanding of an athlete’s chronic headaches helps delineate the difference between the athlete’s concussive headaches versus chronic headache. A history of headache accompanied by a recent concussion warrants further investigation of an unresolved concussion or post-concussive syndrome.

In addition to neurologic injuries to the brain, injury to the peripheral nervous system commonly occurs in sports. Some of the most common injuries seen in contact sports are burners and stingers. These are painful, transient, burning sensations in one of the upper extremities that occur when traction is placed on the shoulder or neck. This traction may stretch or compress the nerves, leading to symptoms of numbness, pain, and weakness in the involved extremity. These injuries generally do not have a long life. Important symptoms of this injury would be bilateral, simultaneous stingers, which is suggestive of an underlying spinal abnormality. Identification of recurrent stingers offers the opportunity for equipment modification to help prevent further nerve injury.

Seizure disorders rarely lead to activity restriction to the competitive athlete. A thorough history of prior seizure activity, current treatment, and level of control are important to ascertain on the PPE.

Paired organs are another area of concern for the physician performing the PPE. The absence or dysfunction of a paired organ, such as kidneys, eyes, or testicles, is essential to know prior to clearing an athlete for competition. Depending on the sport, an athlete with only one functional paired organ may be at high risk for the possibility of injuring the solitary organ. Altered vision in one eye can lead to legal blindness if the functional eye is injured. Eye protection is a crucial implement for this athlete for safe participation. In the situation of an athlete with a single kidney or testicle, there must be a detailed discussion between physician, athlete, and the athlete's parents regarding the risks and benefits of playing certain sports. All parties must be aware that an injury to the functioning organ can significantly alter the athlete's future, both socially and medically. For example, consider the athlete with a single kidney who wants to play football. The risk *and the likelihood of injury to the kidney* must be considered. The expertise of an additional specialist, specific testing, or both, is frequently required. These situations should be discussed and treated individually, with consideration toward the athlete, their sport, and their medical condition.

Some female athletes may experience menstrual dysfunction, as missed or absent menstrual cycles, more often than their un-athletic peers. This is thought to be related to the "energy drain hypothesis," where intensely training athletes consume fewer calories than they expend. Though menstrual dysfunction in female athletes may be common, it is not normal, and could be associated with additional health concerns. A history of a female athlete's menses should be obtained to ensure regularity and open the opportunity to screen for eating disorders. Abnormal menstrual cycle history correlates with lower bone mineral density, which subsequently increases the risk for stress injury to bones. Disordered eating occurs on a spectrum, with the eating disorders anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified, at the most extreme. Amenorrhea is part of the definition of anorexia nervosa, and all individuals with eating disorders are more likely to also have menstrual dysfunction. Alterations in the normal menstrual cycle may be the initial presenting signs of an eating disorder in some athletes. Disordered eating, menstrual dysfunction, and abnormalities in bone health are the three elements of the Female Athlete Triad.<sup>7, 11</sup> Any female athlete

with a history of any one of these elements should be screened for the presence of the others. See chapter 17 for more information on the Triad.

In addition to screening for medical conditions, the PPE is an opportunity to screen for high-risk behaviors. This is particularly helpful in the adolescent and young adult population, a group that traditionally does not often present itself to medical care. The first subset of behaviors is substance use. History of tobacco, alcohol, and illicit drug use should be obtained in addition to supplements used to enhance performance. The next subset rests on risky behaviors such as seat belt use, unprotected sex, and violence. Depending on the scenario that the PPE is performed, obtaining this information may or may not be possible.

The history portion of the PPE sets the stage for screening athletes for potential injury due to sport. Through this questioning system, about 75 percent of problems affecting athletes will be identified.<sup>3</sup> It also provides a framework for the subsequent physical exam. Certain triggers in the history may lead the examiner to focus on particular areas of the exam to uncover any potential problems.

## THE PHYSICAL EXAMINATION

The history portion of the PPE attempts to identify athletes at particular risk for sports injury with a particular focus on the cardiovascular, musculoskeletal, and nervous systems. The physical examination sets out to accomplish the same goals.

Height and weight are measured for all athletes. This gives a global estimate of body composition and helps to classify an athlete who may be over- or underweight. This is particularly important in an era when obesity is becoming an epidemic. Those found to be overweight should be referred for diet and exercise counseling. The underweight athlete may trigger clues toward an underlying eating disorder or problems with weight management in weight-limited sports such as wrestling. Body mass index (BMI), a ratio of a person's weight and height ( $\text{wt in kg/ht in meters}^2$ ), is a good screening tool to determine if an athlete's weight is abnormal. The World Health Organization (WHO) classifies a person with a BMI of under 18.5 to be underweight and with a BMI of over 25 to be overweight.<sup>12</sup>

The head, eyes, ears, nose, and throat (HEENT) exam is the next step of the PPE. The most important component is visual acuity. A standard Snellen eye chart is used to assess best-corrected vision



in each eye; the athlete who wears corrective lenses for daily activities should wear those lenses for the exam. Vision should be 20/40 or better in each eye, with or without correction. Athletes with vision less than 20/40 in one eye are considered to have a single functioning eye. Anisocoria, when one pupil is a different size than its counterpart, is another exam finding that should be documented. If an athlete suffers an acute injury and displays unequal pupils, it would be helpful to know if the anisocoria was present at baseline. If the anisocoria was not present at the baseline exam, the unequal pupils may be indicative of an acute neurological injury. The rest of the HEENT exam should assess the general appearance of these areas. The ears of athletes participating in water sports require particular attention because of the potential for recurrent external ear infections. The oral cavity and teeth should be evaluated for abnormal wear. Dental injuries are common in sports, and athletes should be counseled regarding the importance of mouth guards, particularly in those with orthodontic hardware that may injure the oral cavity.

The cardiac exam is an area of particular focus for the PPE. Blood pressure and pulse are to be measured in all athletes. A heart rate over 100 beats per minute or a blood pressure greater than 140/90 mmHg is considered abnormal. Simultaneous palpation of the radial (wrist) and femoral (groin) pulses is performed to screen for coarctation of the aorta (a narrowing of the main artery coming from the heart) that restricts blood flow to the lower extremities. Particular attention is placed on listening to the heart sounds. Extra heart sounds or murmurs may be identified and can be suggestive of underlying cardiac disease. Different maneuvers may be performed to characterize innocent versus pathologic murmurs. *Any characteristic that suggests the murmur is pathologic precludes participation until further cardiac evaluation can be obtained.* Innocent flow murmurs are common in adolescents, but there are certain characteristics that preclude participation until further cardiac evaluation can be obtained.

When abnormalities are encountered on the cardiovascular exam, an ECG, echocardiogram, stress test, or cardiac consultation may be required to investigate underlying cardiac disease. The 36th Bethesda guidelines were published in 2005 and outlined investigation and return-to-play recommendations for many cardiac conditions. This is a great resource for all physicians caring for athletes.<sup>5</sup>

Examination of the lungs includes listening to breath sounds in all lung fields. Abnormal sounds such as wheezing require further evaluation or treatment.



After examination of the lungs, the athlete should be instructed to lie on their back. All four quadrants of the abdomen are examined manually for masses or organ enlargement. Enlargement of the liver or spleen is a sign of underlying illness and should be investigated. When enlarged, these organs are poorly protected by the overlying ribs and are at risk for injury.

In males, an exam of the external genitalia is performed. The focus of this exam is to ensure the presence of both testicles. Palpation for testicular masses and inguinal hernias is then performed. This represents an opportunity to discuss the importance of the self-administered testicular exam for early detection of testicular cancer, the most common cancer in young males. The genitourinary exam is not part of the PPE for female athletes.

During the course of the exam, an overview of the condition of the athlete's skin should be ascertained. The presence of contagious rashes or infectious lesions are of particular importance in certain sports where there is a high amount of athlete skin-to-skin contact, such as wrestling. Early identification may allow treatment to begin that could prevent outbreaks during the season and prevent the spread of the infection to other athletes.

The musculoskeletal exam follows the medical exam, and there is a great deal of variability in how it is performed. The type of musculoskeletal exam performed is specific to the sport to be played, the level to the athlete, the expertise of the examiner, and the time available for the PPE.

The general musculoskeletal screening exam is a gross evaluation of mobility of each joint and muscle strength in the extremities. This approach is sufficient to determine if athletes possess adequate function to participate in sports, but provides no useful information on the muscular and ligamentous integrity of specific joints.

A joint-specific exam assesses each individual joint for swelling, tenderness, motion, stability, and strength. This can help to identify problems athletes may be experiencing and allow for further investigation. Deficits encountered on this part of the exam can be addressed using therapeutic rehabilitation prior to start of the season. This exam is time consuming and varies greatly based on the examiner's expertise.

A practical approach to the musculoskeletal exam includes the combination of the two techniques mentioned above. A general musculoskeletal screen should be performed for gross abnormalities, and a joint specific exam can be conducted if the history or the exam suggests present injury, past injury, or risk for future injury. Certain joints