Early Sports Specialization: Concerns with Overuse Injuries in Adolescent and Young Adult Athletes

Carl W. Nissen, MD

Early Sports Specialization (ESS) is a growing concern across the globe today. Many different organizations, including the International Olympic Committee (IOC), the National Collegiate Athletic Association (NCAA), the five major professional sports organizations (NFL, MLS, NBA, NHL, MLB), the National Federation of High School athletics (NFHS), and the leading medical organizations (AOSSM, AANA, AMSSM, ACSM, AAP, AAOS) have or are in the process of developing recommendations directed at the medical and performance-based concerns caused by specialization at an early age.

These concerns in general are that ESS leads to isolation of the athlete, interferes with normal identity...
Dear *SportsMed* Reader:

This summer’s *SportsMed* edition explores issues of high importance to our pediatric, adolescent and young adult populations that will undoubtedly be encountered by those providers involved in the care of this patient group.

Although sport specialization has been discussed for decades, the explosion in technology and the commercialization of childhood sports have fueled new interest in this topic. Dr. Nissen’s paper highlights the physical and psychological impact of early sport specialization that should be considered in our discussions with parents regarding their children’s ambitions. So much more needs to be learned on this subject, but the potential for long-term impact of early sport specialization is already apparent.

Drs. Vindheim and Lee offer a thorough clinical review of the pre-participation physical examination. Specifically, they detail key medical aspects of the exam, which is used for medical documentation of clearance for play in school sports, ranging from the pre-adolescent to the college student. The guidance from national societies is highlighted here and can be incorporated into one’s practice.

In continuation of our focus on diagnostic imaging, I include MRI examples of a differential diagnosis of the acute, adolescent knee injury.

As always, we welcome your comments both about the content of this newsletter as well as other issues facing athletes in the state that you are seeing and dealing with.

Sincerely,

Michael J. Medvecky, MD  
Editor, *SportsMed*  
Section Chief of Sports Medicine  
Associate Professor  
Dept. of Orthopaedics & Rehabilitation  
Yale University School of Medicine

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**Committee Chair**  
Carl W. Nissen, MD

**SportsMed Editor**  
Michael J. Medvecky, MD

**Committee Members**  
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CSMS President

**Matthew C. Katz**  
Executive Vice President and CEO

**Questions or Comments?**  
Kelly Raskauskas  
CSMS Vice President of Communications  
kellyr@csms.org
development, increases the potential for burnout or withdrawal from particular sport due to chronic stress, and increases the risk for overuse injuries specific to that sport. Each of these organizations hopes to stem the tide of this progressive problem and is encouraging each of its constituents to educate young athletes, parents, coaches, and youth sports organizations about the problem.

There is not one agreed-upon definition of ESS. However, during a recent multi-organizational think tank held in Rosemont, Illinois this past winter a definition was developed. The group decided that ESS includes:

1. Participation in intense training in organized sports greater than 8 months per year
   a. Essentially year round
2. Participation in one sport to the exclusion for anticipation and other sports
   a. This leads to limited free play overall
3. Involvement in sports as per the above in young, pre-pubertal children in seventh grade or roughly age 12 or below

It is sometimes difficult to determine what injuries should be labeled as overuse and thereby potentially attributable to ESS. As sports specialization and overuse injuries continue to be studied, the etiology, diagnosis, management, and prevention will improve.

Table 1 shows the more commonly agreed-upon overuse injuries that occur in specific sports. In some recent studies, the percentage of the overall injury rate in certain sports presumed to be from overuse has been determined. Sports such as gymnastics and tennis have overuse injury rates equating to 80% of the overall injury rate. Other sports such as baseball, cheerleading, dance, and swimming have extremely high rates as well, felt to be almost two-thirds of the overall injury rate.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Overuse Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball</td>
<td>Little Leaguers shoulder</td>
</tr>
<tr>
<td></td>
<td>Medial epicondylitis</td>
</tr>
<tr>
<td></td>
<td>Ulnar collateral ligament (UCL) injuries</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>Lumbar stress fractures</td>
</tr>
<tr>
<td></td>
<td>Wrist growth injuries</td>
</tr>
<tr>
<td></td>
<td>Shoulder injuries (males primarily)</td>
</tr>
<tr>
<td>Hockey</td>
<td>Femoral acetabular impingement (FAI)</td>
</tr>
<tr>
<td>Swimming</td>
<td>Rotator cuff strains</td>
</tr>
<tr>
<td>Tennis</td>
<td>Rotator cuff strains</td>
</tr>
</tbody>
</table>

The idea of Early Sports Specialization is not a new one. A large number of studies have looked into ESS, all of which show remarkably similar findings. Early sports involvement in competitive junior tennis players has been studied since the mid 90s and was having increasing interest due to the early dropout especially of young talented female players. Gould in 1996 documented this raising significant concern amongst the USTA. This concern continues today as Dr. Neeru Jayanthi, President of the Society for Tennis Medicine and Science, and others have recently reported that individuals participating in high-level tennis competition who specialized early have a 36% higher risk of serious overuse injury and a 27% increased rate of injuries overall. These studies, as well as those from other authors looking at tennis players specifically, have documented the issues of social isolation, decreased overall enjoyment in participation in sports, shortened careers, and more recently the finding that individuals specialized early ultimately participate in fewer sports and recreational activities as adults.

Perhaps the most prototypical overuse injury due to Early Sports Specialization is that of baseball pitchers. What is concerning about pitchers in this setting is that though they have some pain they rarely will stop or address that pain until it has become severe enough to impact their performance. Since the injuries in this group of athletes are rarely a single traumatic or acute injury, these injuries all tend to have a prodrome before the major injury occurs. For many years, multiple authors have worked hard to try to understand what aspects of pitching leads to the high rate of injury – several authors documenting that rate to be 50% or more. For many years, different pitch types have been blamed for the high rate of injuries in pitchers. Throwing breaking pitches at a young age has traditionally been felt by coaches to be the etiology behind this group’s high injury rate. USA Baseball recommends that breaking pitches should not be thrown until the age of 14 and specifically sliders before the age of 16.
In another research vein, the injuries to pitchers have been discussed as perhaps due to poor mechanics. Problems with arm position, poor lower body control, and inappropriate timing of the rotation of the body each has been shown to increase the stress on the pitchers’ arm specifically. However, within the lab setting the stresses of throwing breaking pitches have been shown to be less than those when throwing a fastball. Similarly, the biomechanical flaws in a pitcher’s motion are not able to fully answer the question of baseball pitchers arm injury etiology.

Because of this, and in line with the concern about pitching injuries, overuse has increasingly been discussed as an etiology. In the 1960s, articles began to talk about young pitchers throwing too often or too frequently during a game, a week, a season, or even over the course of a year. Recently, more widespread clinical studies have reinforced the concern that injury rates are very high, with pitchers missing a day or more of play in greater than 50% overall. Looking deeper at this group of injured pitchers, one particular recent study documented that injury rate increased threefold when individuals pitch for multiple teams, pitch on consecutive days, pitch when they were they were fatigued, or when they pitched with arm pain. Even armed with this information, young pitchers were found in a follow-up study at the end of the succeeding year to still be engaged in many of these concerning, risky behaviors. Therefore though it seems to be clear that limiting types of pitches thrown, educating young pitchers as to proper mechanics, and regulating the overall number of pitches thrown should limit injury rates significantly more needs to be done.

A similar line of thinking exists regarding youth tennis, where overuse injuries are a big issue. Clinical studies of young tennis players have shown specialization to the exclusion of other sports leads increased injury rates, and also a deleterious effect on performance. Players identified as having specialized in tennis before 10-1/2 years of age were much more likely to medically withdraw from tournaments than those who did not specialize. Additionally, the studies have found that the same specialized tennis players had a fivefold increase in the risk of injury. Looking deeper, these studies demonstrated that players practicing and playing greater than 16 hours per week, whether they were early specializers or not, also had higher rates of medical withdrawal from tournaments and a higher injury rate. These results have led the USTA to create what they believe are ideal training program regimens, as well as limits on the play that individual junior elite level players may participate in. The recommendations for 12-year-old and under junior tournament players are:

1. Practice and play less than 12 hours per week
2. Play no more than 12 tournaments per year
3. Play a second sport as a part of a regular off-season
4. Engage in 2+ hours per week of injury prevention and/or cross-training.

Unfortunately, in reality if a 12-year-old tennis player who is working towards being an elite level player limits him or herself from competing in less than 12 tournaments per year, he/she will not be able to establish high ranking in the current USTA ranking system and thereby jeopardize their progression. So, despite the best of intentions, without a rule change, these ESS/Overuse recommendations are not acceptable to any aspiring young players.

Early Sports Specialization and overuse often lead to high-visibility injuries. While these injuries are a concern and need to be further evaluated and discussed, it is some of the less visible injuries that need to be understood and studied even more. One such injury is that of burning out. Burnout, often thought to be purely psychological in nature, also has a significant physical aspect. The “burnt out” athlete conjures up the image of a depressed and sullen athlete, but the concept has other issues, including: overreaching and overtraining. Overreaching is defined as intense training to a level that leads to decreased performance and psychological symptoms. Somebody suffering from overreaching, though concerning, will in most cases fully recover after an appropriate period of rest. This is compared to overtraining syndrome, which could be grossly described as extreme overreaching. In overtraining syndrome individuals suffer:

1. Decreased performance for greater than 2 months
2. Psychological issues including depression, anxiety, and eating disorders
3. Develop maladaptive physiology.

Overtraining syndrome has been poorly described and relatively unstudied in children. What has been noted however in young athletes is that the overtraining syndrome has a much larger psychological component than it does in adults.

Formalized study of burnout has been done for 30 years. In 1986 R.E. Smith noted that burnout had an unknown etiology, but that 30-35% of individuals that he spoke with experience some form of overreaching. His studies led him to describe burnout as a “response to chronic stress in which a young athlete ceases to participate in a previously enjoyable activity.” So the question is not whether overreaching or overtraining syndrome exist, but rather where did they come from?
Nearly three decades ago, K. Anders Ericsson discussed the role of deliberate practice in the “acquisition of expert performance.” He clearly showed that with increased practice violinists had an increased chance of achieving expert levels of performance. Subsequent to that, Malcolm Gladwell’s articles and books appeared, describing the importance of 10,000 hours of deliberate practice over a period of ten years in order to achieve high levels of performance. This notion of deliberate practice was not established to describe appropriate behavior in young athletes – and perhaps not even in musicians. In fact, more recent scientific articles have determined that although deliberate practice is helpful in improving skills, it accounts for only 21% of a musician’s ability and only 18% of an athlete’s. Despite that, many organizations and nations began to identify individuals who might be able to excel in particular sport.

This idea of early talent identification or selection perhaps was no better exemplified then by the East German sports programs in the 1970s and 1980s, and some of the Chinese training programs in the early 2000s. Successes of these programs made every nation and all young athletes begin to consider the validity of this approach. However, over the past ten years as the performance of these individuals and how they ultimately have performed was able to be reviewed, a slightly different finding can be seen. Guellich in 2014 reported that over the previous 20 years, the highest level soccer players in Germany had, on average, participated in multiple sports and not purely in soccer, compared with those who had not attained that high level. Interestingly, Guellich and Emrich had previously reported the members of the German Elite soccer teams to a great extent credited their success to higher training volumes and involvement in other sports. Snyder repeated the same clinical retrospective study in the United States, where Olympic athletes believed that their multi-sport involvement helped their overall development and their high levels of achievement. In another US-based study, Difiori in 2014 reported that scholarship athletes at UCLA between 2012 – 2014 began their specialization at an average of 15.4 years of age. Athletes competing in the same sports at the intramural level specialized on average at 14.2 years of age. In Sweden, it was shown that individuals in the national ice hockey program who never made it beyond the sub-elite level specialized on average at 11 years of age. This is compared to those that made it to the Elite national team level, who on average participated in multiple sports up until the age of 14.

A discussion about Early Sports Specialization does need to include that there are some positive aspects of doing so. There is no question that individuals who specialize early and succeed in achieving a higher level at a young age are provided with better coaching and better skill instruction. Further, these individuals because of their early specialization and better coaching, have enhanced skill acquisition. During the time of this skill acquisition, they by necessity become better at time management, understanding how to structure their time in a more productive way, and at least at the youngest ages enjoy their sport and their talent development. This says nothing of the high accolades these young individuals get from their peers. The corollary to this is the high cost of time demands and achievement placed on these young individuals, leading to the high rates of burnout, loss of motivation, and the increased stress and pressure they feel from themselves, their parents, their teams, and their coaches.

There are some notable exceptions, where Early Sports Specialization is appropriate or necessary. The physiologic demands in the sports of gymnastics, figure skating, and dance virtually require the highly flexible nature of a young body. Until those sports undergo a change in judging and scoring, it will remain necessary for individuals to specialize at a very early age. However, beyond those sports narrowing and the many well-documented concerns about early specialization, there is also a very pervasive feeling amongst coaches at the highest levels who would rather not accept or recruit single-sport, highly-specialized athletes. College soccer, basketball and lacrosse coaches commonly recruit and look for multisport athletes, as they feel that these athletes have better overall sense and understanding of sports in general, in addition to having a lower possible burnout rate.

The International Olympic Committee has recently come up with a consensus statement regarding early specialization. The goal of their statement was to encourage the development of healthy, capable, resilient young athletes while attaining widespread, inclusive, sustainable, and enjoyable participation for these young athletes at all levels. The IOC was concerned that early specialization was leading to insufficient sleep, increased overuse injury rate, overtraining, burnout, and eating disorders. Their recommendations encourage participation in a variety of different activities to develop a wide range of skills in order to develop competence, confidence, connection, and character. Child development research has shown that individuals with early specialization often do not develop typical neuromuscular patterns, leading to higher injury risks. One hypothetical example of this is an individual who specializes a very early age in the sport of soccer. That individual then goes on to participate in a high level and when challenged with a ball hit towards his or her head or body lacks the neuromuscular coordination to protect him to defend himself from being hit. Though somewhat extreme, this example at least presents an idea to be considered.

From all of the studies and discussions about early sports specialization, major organizations across United States have come up with some clear recommendations. These recommendations include the following: (continued on page 6)
1. Participate in organized, deliberate practice no more hours per week than the athlete’s age.
2. Intense exercise should be less than 16 hours per week.
3. Diversification and sampling should occur until an individual reaches high school age.
4. Multiple teams or sports participation simultaneously should be avoided.
5. The athlete should participate in his/her chosen sport less than eight months per year, once specialized.

Summary

Early Sport Specialization leads to several physical and psychological maladies. Though this is known to exist, individuals at an increasing rate are specializing early in specific sports and the consequent rate of overuse injuries is increasing. Further studies to identify the specific causes and gain a better understanding are important in order help maintain the health and safety of young athletes.

Dr. Nissen practices at Elite Sports Medicine, Connecticut Children’s Medical Center. He is a Professor of Orthopedics, University of Connecticut.

References


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Parents, schools, and athletes want the assurance that an athlete is physically able to participate in sports without the risk of incurring injury or death due to a preexisting medical condition. Often the PPPE is the first interaction between the physician and the athlete, but does not take the place of their regular yearly physical. In fact, many people think that a sports examination is just another annual routine physical examination. This is not true. Besides clearing an athlete to play a sport, the examination has many other purposes as outlined below. The PPPE (pre-participation physical examination) is not meant to exclude athletes from participating in sports but is done to ensure their safety. It also provides education and information to athletes about issues such as nutrition, supplementation, training and conditioning, injury prevention, and rehabilitation.

Goals of the Pre-Participation Physical Examination

1. Emphasize cardiovascular, neurologic, and musculoskeletal issues.
2. Identify any life-threatening or disabling conditions (e.g., underlying cardiovascular or neurologic abnormalities).
3. Identify any conditions that may place athlete at risk for injury or illness (e.g., underlying ligamentous instability, musculoskeletal abnormalities, organomegaly, diabetes, asthma, seizures, or acute medical illness).
4. Assess for an injury that has not been properly rehabilitated.
5. Assess for medical conditions and strength and flexibility deficits that place athletes at risk for injury (and assist in matching participants with appropriate sport or position).
6. Assess general health status (immunizations), fitness, and maturity.
7. Meet insurance or legal requirements (protects the school and the physician from litigation).
8. Screen for menstrual dysfunction, stress fractures, eating disorders (female athlete triad).
9. Introduce athletes to health care system and preventative medicine concepts.
10. Offer an opportunity to address issues such as recreation and performance-enhancing substance use and abuse, sexuality issues, depression and emotional issues, and health promotional activities (seat belts, helmets, self breast or testicular examination, Tanner staging present).

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Examination Format: Settings

1. **Office examination with private physician** – This can be part of a regular comprehensive examination or be more sports specific.
   **Advantages**
   - More personal due to physician-patient familiarity
   - Provides continuity of care (pre-existing medical records are available showing injury patterns from previous sports seasons)
   - Allows an opportunity for counseling (school, safety, sex, STDs, drugs, peers, etc.)
   **Disadvantages**
   - Physicians have varying interest/knowledge in sports medicine (non-standardized examination)
   - Many athletes do not have a primary physician
   - It is difficult to screen large numbers of athletes
   - The cost of the office visit
   - The physician often has no contact with the trainer or coach

2. **Locker room examination** – This type of examination is usually performed by a school or volunteer physician(s) and is not recommended. It is often in a locker room and sometimes is performed after the sports season has started. The examination is impersonal and unpleasant with little privacy. It is limited in scope with little time for counseling or educations. It is often hurried and cursory.

3. **Station examination** – Athletes are often examined in one location by one or more physicians and other health professionals (Trainer, Nurse Practitioner, Nurse, or Physical Therapist) and coaches.
   **Advantages**
   - Performed by specialists in Sports Medicine
   - More standardized and can provide data to evaluate the effectiveness of the exam
   - Large numbers of athletes can be screened in a short time
   - More cost effective
   - Specialists can often be brought in to assess fitness, performance, and diet
   **Disadvantages**
   - A large space is required
   - It can be noisy and disorganized
   - It can be hurried with a lack of privacy
   - There is poor communication with parents
   - There is difficulty with following up on medical problems or concerns

Listed below is a summary of the type of stations one can use:

<table>
<thead>
<tr>
<th>Stations</th>
<th>Personnel Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign-in, weight, height, vital signs, vision</td>
<td>Coach, nurse</td>
</tr>
<tr>
<td>Flexibility, strength, body fat</td>
<td>Trainer, physical therapist</td>
</tr>
<tr>
<td>History review, physical examination, assessment/clearance</td>
<td>Physician</td>
</tr>
</tbody>
</table>

Examination Format: Timing

1. **Frequency of the examination**
   - The CIAC recommends an annual examination for high school students, as this is often the only time adolescents visit their doctor.
   - Any injury sustained in one sport should be reassessed prior to starting a sport in a new season (this is especially important for students who play one sport for multiple seasons as well as more than one sport a year)

2. **Scheduling**
   - Ideally the examination should be scheduled at least six weeks prior to the start of training and practice, but at least a minimum of two weeks before practice begins. This allows time for the correction and rehabilitation of any problems found on the PPPE.
   - Schools need to send out the sports form 2-3 months before the season starts to avoid the last minute rush that ends up having the examination done in the walk-in center.

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Athletes should be encouraged to have their examinations earlier in the summer rather than waiting until the day before practice begins. Since many health insurance plans cover only one annual examination, schools should not require all sports examinations to be done prior to June 1st or any other specified date.

**Sport-Specific Examinations**

It is important to know the types of injuries that occur in different sports as well as which sports are most at risk for injury. The sports examination needs to be tailored to the sport the athlete is involved with. Some examples include:

- **Football** has the highest injury rate per 100 participants compared to other sports. Common injuries in football include the knee/ankle, neck/back, and head. These areas need special evaluation.
- **Wrestling** has a high injury rate especially involving the neck, shoulders, and knees. In addition one also has to evaluate an athlete's nutrition, weight control, and any skin rashes.
- **Track/cross country** needs evaluation for lower extremity alignment, flexibility, training schedule, type of surfaces running on, and types of footwear.
- **Basketball** needs to have females evaluated for lower body strength and flexibility due to the increasing incidence of anterior cruciate ligament injuries of the knees. Quadriceps strength and jumper’s knee need evaluation.
- **Ballet/dance/gymnastics** have high rates of foot, ankle, and spine injuries (especially spondylolysis [stress fracture] in gymnastics). Menstrual function and nutrition needs to be assessed.
- **Throwing/racket sports** need closer evaluation of the shoulder, elbow, and wrist.

**The PPE History**

The cornerstone of the PPE is the medical history. The history part of the form should be filled out by the athlete or the athlete’s parents/guardians if the athlete is under age 18. It is also important that parents be present to answer questions about the history that may arise during the examination.

The areas of greatest concern in the history are cardiac and pulmonary problems, including exertional syncope, dizziness during and after exercise, chest pain during and after exercise, heart murmur, skipped beats, and a family history of heart problems. Family history is important, as 25% of first-degree relatives of patients with HCM have morphologic evidence in echocardiography. Also, prior patient or family history of hypertension/pre-hypertension may be picked up on exam, requiring further follow up. Asthma and exercise induced bronchospasm need evaluation as well.

**Table. The 12-Element AHA Recommendations for Preparticipation Cardiovascular Screening of Competitive Athletes**

<table>
<thead>
<tr>
<th>Medical History*</th>
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</thead>
<tbody>
<tr>
<td><strong>Personal History</strong></td>
</tr>
<tr>
<td>1. Exertional chest pain/discomfort</td>
</tr>
<tr>
<td>2. Unexplained syncope/near-syncope†</td>
</tr>
<tr>
<td>3. Excessive exertional and unexplained dyspnea/fatigue, associated with exercise</td>
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<tr>
<td>4. Prior recognition of a heart murmur</td>
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<tr>
<td>5. Elevated systemic blood pressure</td>
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<tr>
<td><strong>Family History</strong></td>
</tr>
<tr>
<td>6. Premature death (sudden and unexpected, or otherwise) before age 50 years due to heart disease, in ≥1 relative</td>
</tr>
<tr>
<td>7. Disability from heart disease in a close relative &lt;50 years of age</td>
</tr>
<tr>
<td>8. Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome or other ion channelopathies, Marfan syndrome, or clinically important arrhythmias</td>
</tr>
<tr>
<td><strong>Physical Examination</strong></td>
</tr>
<tr>
<td>9. Heart murmur‡</td>
</tr>
<tr>
<td>10. Femoral pulses to exclude aortic coarctation</td>
</tr>
<tr>
<td>11. Physical stigmata of Marfan syndrome</td>
</tr>
<tr>
<td>12. Brachial artery blood pressure (sitting position)§</td>
</tr>
</tbody>
</table>

*Parental verification is recommended for high school and middle school athletes.
†Judged not to be neurocardiogenic (vasovagal); of particular concern when related to exertion.
‡Auscultation should be performed in both supine and standing positions (or with Valsalva maneuver), specifically to identify murmurs of dynamic left ventricular outflow tract obstruction.
§Preferably taken in both arms.
Neurological concerns include history of previous head or neck injury, concussion, neurologic symptoms, stingers/burners, and seizure disorder. A more thorough history and physical may be required if a positive response is found for any of these questions.

Previous musculoskeletal injuries and their rehabilitation are inquired about.

Recent or Chronic Medical Problems including hospitalizations, recent infectious mononucleosis, diabetes, heat exhaustion/illness, Hepatitis, HIV disease, and Sickle cell disease.

In females it is extremely important to evaluate the section of the history related to menstrual periods, as this may indicate other issues including female athlete triad, PCOS, thyroid issues, and nutritional deficiencies.

Medications the athlete is on (including performance enhancing substances), allergies, and immunization status should be assessed. This includes protein supplementation, as some protein powder bases may include caffeine or steroid additives. Ask baseball players if they chew tobacco or dip.

While the absence of a paired organ may not exclude an athlete, it should be noted. Sometimes a waiver to play may need to be signed.

**Physical Examination**

Sports-specific components in addition to the regular examination:

- Check pupil size for anisocoria (unequal pupils) in athletes involved in collision sports. This is important to know prior to a head injury, as this could be an existing issue.
- Check neck range of motion and strength, particularly in football players and wrestlers.
- The heart should be examined in both the seated and supine positions since often murmurs in the supine (lying down) position disappear with sitting up.
- The spleen should be examined by both palpation and percussion.
- Besides scoliosis, check for posterior root pain and range of motion of the spine (especially in gymnasts).
- Decreased size (unilateral) of the vastus medialis muscle(s) may indicate prior injury and risk for patellofemoral pain syndrome.
- When dealing with injuries to specific joints, one needs to examine the specific joint involved with comparison to its paired joint. As an example, knowing how to evaluate a knee and checking an ankle injury for loss of proprioception is part of the sports examination.
- Evaluation for pes planus, genu valgum positioning of the knees, scoliosis, and postural issues.
- Measurement of body fat can be helpful to athletes (especially wrestlers).

To help evaluate the musculoskeletal system, a quick two-minute handout is included with this article (at right).²

**Laboratory Tests**

- Most physicians recommend no tests be done, but some recommend that a urinalysis should be performed looking for hematuria or proteinuria.
- Hemoglobin/hematocrit/serum ferritin are not routinely done on female athletes but should be ordered if there is a previous history of anemia/heavy menstrual bleeding. One may also include a Total Iron Binding Capacity and Reticulocyte count.
- Calcium and Vitamin D levels are not recommended, but, especially with young female adolescents, assessment of adequate Calcium intake is important. Supplements may be needed.
- Routine EKGs and echocardiograms, and chest x-rays, are not recommended. If there is a concern for cardiac issues it may be prudent to obtain a Cardiology consult (e.g., heart murmur, family history of sudden death or heart attack before age 50).
The Pre-Participation Physical Examination
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References


Additional Resources


For sample Pre-Participation Physical Examination Forms, please see pages 13 – 16.

Spotlight on Diagnostic Imaging: MRI
Michael J. Medvecky, MD

This section provides visual examples of clinically relevant diagnostic imaging findings for clinical conditions or chief complaints that are commonly encountered in the outpatient office setting. It will serve as a review of a differential diagnoses for a specific patient population, anatomical region, and a clinical scenario.

A 16-year-old female high school sophomore soccer player sustains an acute non-contact knee injury when planting and pivoting on the field. She has immediate pain and is unable to continue participation. She develops an effusion over the next 24 hours and has limited range of motion, lacking 10 degrees of full extension and only able to flex to 90 degrees.

A differential diagnosis of this injury is:

- Acute anterior cruciate ligament (ACL) tear
- Patellar dislocation
- Meniscus tear (possible bucket-handle meniscus tear given the extension loss)
- Osteochondral fracture
- Osteochondritis dessicans (OCD) lesion
- At 16, her physes would typically be closed, so concern for distal femur or proximal tibia physeal injury is very low in this age group.

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Figure 1. Proton density weighted sagittal image showing acute ACL tear from the femoral attachment site.

Figure 2. T2 weighted sagittal image highlighting the edema within the ACL.

Figure 3. T2 weighted sagittal image demonstrating typical bone bruise pattern associated with an acute ACL tear (antero-lateral distal femur and postero-lateral proximal tibia).

Figure 4. Proton density weighted image demonstrating posterior horn medial meniscus tear.

Figure 5. Proton density weighted sagittal image demonstrating bucket-handle medial meniscus with two anterior horns seen.

Figure 6. Proton density weighted sagittal image demonstrating bucket-handle medial meniscus with double-PCL sign (body of medial meniscus seen under the normally situated PCL).

Figure 7. Proton density weighted coronal image demonstrating bucket-handle medial meniscus with body of medial meniscus within the intercondylar notch and a smaller medial meniscus mid-body due to the displaced fragment.

Figure 8. T2 weighted axial image demonstrating edema of lateral condyle due to patella dislocation.

Figure 9. T2 weighted sagittal image demonstrating edema of lateral condyle due to patella dislocation.

Figure 10. Proton density weighted sagittal image demonstrating displaced osteochondral fragment from patella dislocation (donor site is the patella).

Figure 11. T2 weighted sagittal image demonstrating edema adjacent to an OCD lesion consistent with an unstable OCD lesion.

Figure 12. T2 weighted coronal image demonstrating edema adjacent to an OCD lesion consistent with an unstable OCD lesion.
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 ____________________________  Date of birth ____________________________

Name ___________________________________________  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.

<table>
<thead>
<tr>
<th>GENERAL QUESTIONS</th>
<th>MEDICAL QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has a doctor ever denied or restricted your participation in sports for any reason?</td>
<td>Yes No</td>
</tr>
<tr>
<td>2. Do you have any ongoing medical conditions? If so, please identify below: ☐ Asthma  ☐ Anemia  ☐ Diabetes  ☐ Infections  ☐ Other:</td>
<td>26. Do you cough, wheeze, or have difficulty breathing during or after exercise? Yes No</td>
</tr>
<tr>
<td>3. Have you ever spent the night in the hospital?</td>
<td>27. Have you ever used an inhaler or taken asthma medications? Yes No</td>
</tr>
<tr>
<td>4. Have you ever had surgery?</td>
<td>28. Is there anyone in your family who has asthma? Yes No</td>
</tr>
<tr>
<td>5. Have you ever passed out or nearly passed out DURING or AFTER exercise?</td>
<td>29. Were you born without or are you missing a kidney, an eye, a testicle (male), your spleen, or any other organ? Yes No</td>
</tr>
<tr>
<td>6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?</td>
<td>30. Do you have groin pain or a painful bulge or hemaia in the groin area? Yes No</td>
</tr>
<tr>
<td>7. Does your heart ever race or skip beats (irregular beats) during exercise?</td>
<td>31. Have you had infectious mononucleosis (mono) within the last month? Yes No</td>
</tr>
<tr>
<td>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:</td>
<td>32. Do you have any rashes, pressure sores, or other skin problems? Yes No</td>
</tr>
<tr>
<td>9. Has a doctor ever ordered a test for your heart? (For example, ECG/EKG, echocardiogram)</td>
<td>33. Have you had a herpes or MRSA skin infection? Yes No</td>
</tr>
<tr>
<td>10. Do youget lightheaded or feel more short of breath than expected during exercise?</td>
<td>34. Have you ever had a head injury or concussion? Yes No</td>
</tr>
<tr>
<td>11. Have you ever had an unexplained seizure?</td>
<td>35. Have you ever had a hit or blow to the head that caused confusion, prolonged headache, or memory problems? Yes No</td>
</tr>
<tr>
<td>12. Do you get more tired or short of breath more quickly than your friends during exercise?</td>
<td>36. Do you have a history of seizure disorder? Yes No</td>
</tr>
<tr>
<td>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)?</td>
<td>37. Do you have headaches with exercise? Yes No</td>
</tr>
<tr>
<td>14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, cardiomyopathies, or conduction system diseases? Yes No</td>
<td>38. Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling? Yes No</td>
</tr>
<tr>
<td>15. Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?</td>
<td>39. Have you ever been unable to move your arms or legs after being hit or falling? Yes No</td>
</tr>
<tr>
<td>16. Has anyone in your family had unexplained fainting, unexplained seizures, or near drowning?</td>
<td>40. Have you ever become ill while exercising in the heat? Yes No</td>
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<table>
<thead>
<tr>
<th>BONE AND JOINT QUESTIONS</th>
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<tbody>
<tr>
<td>17. Have you ever had an injury to a bone, muscle, ligament, or tendon that caused you to miss a practice or a game?</td>
<td>Yes No</td>
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<tr>
<td>18. Have you ever had any broken or fractured bones or dislocated joints?</td>
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<tr>
<td>19. Have you ever had an injury that required x-rays, MRI, CT scan, injections, therapy, a brace, a cast, or crutches?</td>
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<td>20. Have you ever had a stress fracture?</td>
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<td>21. Have you ever been told that you have or have had an x-ray for neck instability or atlantoaxial instability? (Down syndrome or dwarfism)</td>
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<tr>
<td>22. Do you regularly use a brace, arthritis, or other assistive device?</td>
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<tr>
<td>23. Do you have a bone, muscle, or joint injury that bothers you?</td>
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<tr>
<td>24. Do any of your joints become painful, swollen, feel warm, or look red?</td>
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<tr>
<td>25. Do you have any history of juvenile arthritis or connective tissue disease?</td>
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</table>

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 ____________________________

Preparticipation Physical Evaluation

THE ATHLETE WITH SPECIAL NEEDS: SUPPLEMENTAL HISTORY FORM

Date of Exam ____________________________ Date of birth ____________________________

Name ____________________________ 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

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>5. Do you regularly use a brace, assistive device, or prosthesis?</td>
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<tr>
<td>7. Do you use any special brace or assistive device for sports?</td>
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<tr>
<td>8. Do you have any rashes, pressure sores, or any other skin problems?</td>
<td></td>
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<tr>
<td>9. Do you have a hearing loss? Do you use a hearing aid?</td>
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<tr>
<td>10. Do you have a visual impairment?</td>
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<tr>
<td>11. Do you use any special devices for bowel or bladder function?</td>
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<tr>
<td>12. Do you have burning or discomfort when urinating?</td>
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<tr>
<td>13. Have you had autonomic dysreflexia?</td>
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<tr>
<td>14. Have you ever been diagnosed with a heat-related (hyperthermia) or cold-related (hypothermia) illness?</td>
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<tr>
<td>15. Do you have muscle spasticity?</td>
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<tr>
<td>16. Do you have frequent seizures that cannot be controlled by medication?</td>
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</tbody>
</table>

Explain “yes” answers here ____________________________________________________________

__________________________________________________________

__________________________________________________________

Please indicate if you have ever had any of the following

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

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 ____________

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, helpless, 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

<table>
<thead>
<tr>
<th>Height</th>
<th>Weight</th>
<th>Male</th>
<th>Female</th>
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</thead>
<tbody>
<tr>
<td>BP</td>
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<tr>
<td>/</td>
<td>/</td>
<td>Pulse</td>
<td>Vision R 20/</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEDICAL</th>
<th>NORMAL</th>
<th>ABNORMAL FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>• Marfan stigmata (hypospadias, high-arched palate, pectus excavatum, arachnodactyly, arm span &gt; height; hypertelorism, myopia, MVP, aortic insufficiency)</td>
<td></td>
</tr>
<tr>
<td>Eyes/ears/nose/throat</td>
<td>• Pupils equal</td>
<td>• Hearing</td>
</tr>
<tr>
<td>Lymph nodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td>• Murmurs (auscultation standing, supine, +/- Valsalva)</td>
<td>• Location of point of maximal impulse (PMI)</td>
</tr>
<tr>
<td>Psoas</td>
<td>• Simultaneous femoral and radial pulses</td>
<td></td>
</tr>
<tr>
<td>Lung</td>
<td></td>
<td></td>
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<tr>
<td>Abdomen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genitalia</td>
<td></td>
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<tr>
<td>Skin</td>
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<td></td>
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<tr>
<td>Neurologic</td>
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<td></td>
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</tbody>
</table>

MUSCULOSKELETAL

<table>
<thead>
<tr>
<th>Neck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
</tr>
<tr>
<td>Shoulder/arm</td>
</tr>
<tr>
<td>Elbow/forearm</td>
</tr>
<tr>
<td>Wrist/hand/forearm</td>
</tr>
<tr>
<td>Hip/thigh</td>
</tr>
<tr>
<td>Knee</td>
</tr>
<tr>
<td>Leg/ankle</td>
</tr>
<tr>
<td>Foot/leg</td>
</tr>
<tr>
<td>Functional</td>
</tr>
</tbody>
</table>

*Consider EKG, echocardiogram, and refer to cardiologist for abnormal cardiac history or exam.
*Consider GU exam if in private setting. Having third party present is recommended.
*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 ___________________________


HE030 9-263/010
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 ____________________________

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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/typed) ____________________________ Date ____________

Address __________________________________ Phone __________________________________

Signature of physician ____________________________ MD or DO

EMERGENCY INFORMATION

Allergies ____________________________

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Other information ____________________________

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