

A thorough yet efficient exam identifies most problems in school athletes

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Practice recommendations

- A complete medical history, preferably from the student and a parent, will reveal approximately 75% of problems affecting initial athletic participation (D).
- For asymptomatic athletes with no previous injuries, a 90-second screening musculoskeletal test will detect 90% of significant musculoskeletal injuries (A).
- A routine screening need not include noninvasive cardiac testing or laboratory tests such as urinalysis, blood count, chemistry profile, lipid profile, ferritin level, or spirometry (B).

Is the preparticipation physical examination the best way to determine whether a student athlete can participate fully in his or her chosen sport? This examination has become the standard of care for the over 6 million high school and college students. While most athletes pass the exam without significant medical or orthopedic abnormalities being noted, it often detects conditions that may predispose an athlete to injury or limit full participation in certain activities. We describe an efficient approach to the preparticipation examination.

Although many organizations have adopted the preparticipation exam there has been considerable debate on its content and usefulness.¹⁻⁴ Nevertheless, sponsoring institutions continue to require the medical evaluation prior to competition in organized athletics, so family physicians should be knowledgeable about the objectives and limitations of the exam.

The American Academy of Family Physicians, the American Academy of Pediatrics, the American Medical Society for Sports Medicine, the American Orthopedic Society for Sports Medicine, and the American Osteopathic

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Most conditions requiring further evaluation or restriction will be identified in the medical history

Academy of Sports Medicine established the Preparticipation Physical Examination Task Force. The recommendations of this task force serve as a guide for the physician conducting these examinations for high school and collegiate athletes.^{5,6}

■ ASSESSING RISKS OF MORTALITY AND MORBIDITY

The mortality associated with athletic participation is most often the result of sudden cardiac death, which occurs in about 0.5 per 100,000 high school athletes per academic year and is most commonly due to hypertrophic cardiomyopathy.^{7,8} Screening for predisposing conditions is limited by the low prevalence of relevant cardiovascular lesions in the general youth population, the low risk of sudden death even among persons with an unsuspected abnormality, and the large number of school athletes.⁷⁻⁹

An estimated 200,000 children and adolescents would have to be screened to detect the 500 athletes who are at risk for sudden cardiac death and the 1 person who would actually experience it.¹⁰ Even when cardiac abnormalities are detected, the findings leading to disqualification are most often rhythm and conduction abnormalities, valvular abnormalities, and systemic hypertension, which are not the cardiac abnormalities usually associated with sudden cardiac death in athletes.^{11,12}

The majority of sudden deaths are associated with 4 sports: football, basketball, track, and soccer. Approximately 90% of athletic-field deaths have occurred in males, mostly high school athletes.^{7,13}

More frequently than mortality, athletic participation places the individual at risk for acute injury or worsening of an underlying medical condition. These conditions are most commonly

musculoskeletal, cardiovascular, or ophthalmologic (**Table 1**).^{5,9,21}

Nine studies of the preparticipation exam done between 1980 and 1999 show general agreement on the rates at which it qualifies (84.8% to 96.6%), qualifies with conditions (3.1% to 13.9%), and disqualifies students for sports participation (0.2% to 2.6%).¹⁴⁻²²

■ WHAT SHOULD THE MEDICAL HISTORY INCLUDE?

The examining physician should obtain a medical history from each participant (strength of recommendation [SOR]: **D**). A complete medical history will identify approximately 75% of problems that will affect initial athletic participation and serves as the cornerstone of the exam.^{14,19} Most conditions requiring further evaluation or restriction will be identified from the medical history. Rifat and colleagues²¹ noted that a complete medical history accounted for 88% of the abnormal findings and 57% of the reasons cited for activity restriction. The Preparticipation Physical Evaluation Task Force has developed a history form that emphasizes the areas of greatest concern.⁵

In particular, examining physicians should ask regarding risk factors and symptoms of cardiovascular disease (**Table 2**). You should confirm a positive response to any of these questions, and conduct further evaluation if necessary. Unfortunately, most athletes with hypertrophic cardiomyopathy do not report a history of syncope with exercise or a family history of premature sudden cardiac death due to the disease.

Musculoskeletal injury is a common cause for disqualification of an athlete.^{14,19,21} The most common injury to restrict participation is a knee injury, with an ankle injury the next most common.²³ The strongest independent predictor of sports injuries is a previous injury (odds ratio [OR]=9.4) and exposure time (OR=6.9).²⁴ DuRant and colleagues²³ found that a previous knee injury or knee surgery was significantly associated with further knee injuries during the

TABLE 1

Medical and orthopedic conditions resulting in additional evaluations

	Rifat, 1995*		Lively, 1999†
	n=2,574		n=596
	Pass with follow-up and/or restriction (12.6%)	Fail with follow-up (2.6%)	Follow-up or restriction (14.1%)
Medical (% of overall total)	76.6	74.1	55.4
Cardiovascular	18.3	35.0	63.0
Dermatologic	6.8		
Endocrinologic	0.4		
Ear, nose, and throat	9.6	2.5	
Gastrointestinal	0.9		2.2
Genitourinary	9.6	12.5	8.7
Gynecologic			4.4
Infectious	0.4		6.5
Neurologic			6.5
Ophthalmologic	26.0	25.0	6.5
Psychological			2.2
Pulmonary	14.2	2.5	
Other‡	13.7	22.5	
Total medical (%)	100.0	100.0	100.0
Orthopedic (% of overall total)	23.4	25.9	44.6
Ankle/Foot	14.9	7.7	2.7
Back/Neck	22.4	14.3	5.4
Elbow			5.4
Hand/Wrist	1.5		10.9
Knee	41.8	7.1	43.2
Leg			5.4
Shoulder			27.0
Nonspecific pain/injury	19.4	71.4	
Total orthopedic (%)	100.0	100.0	100.0

*Studied junior high and high school students. Two individuals failed (nonspecific pain/injury).

†Studied college-aged students. One individual failed (complicated pregnancy).

‡"Other" includes abdominal pain, allergy, bruising, chest pain, chronic/recurrent illness, dizziness/syncope with exercise, surgery (recent).

TABLE 2

Questions to help discern cardiovascular risk

Have you ever passed out during or after exercise?
Have you ever been dizzy during or after exercise?
Have you ever had chest pain during or after exercise?
Do you get tired more quickly than your friends during exercise?
Have you ever had racing of your heart or skipped heartbeats?
Have you ever had high blood pressure or high cholesterol?
Have you been told you have a heart murmur?
Has any family member or relative died of heart problems or of sudden death before age 50?
Have you had a severe viral infection (for example, myocarditis or mononucleosis) within the last month?
Has a physician ever denied or restricted your participation in sports for any heart problem?

subsequent sports season when compared with individuals who did not report previous knee injury or surgery (30.6% vs. 7.2%, $P=.0001$).

Additional historical information has been recommended for inclusion (SOR: **D**). For example, the examining physician should question the athlete about wheezing during exercise. Due to the high rate of recurrence and potential for long-term adverse effects, he or she should also obtain a history of previous concussions. Other issues to be addressed include presence of a single bilateral organ and use of performance-enhancing medication. Finally, physicians should question female athletes regarding their menstrual history and other symptoms or signs of the female athletic triad (eating disorder, amenorrhea, and osteoporosis).

Always carefully review the information provided by the athlete and his or her parents. In 2 separate studies, minimal agreement was found between histories obtained from athletes and parents independently.^{19,25} We do not know which source provides the most accurate history; therefore, both the parents and student athlete should be questioned.

■ WHAT SHOULD THE PHYSICAL EXAMINATION INCLUDE?

A complete physical examination is not necessary (SOR: **D**).⁵ The screening physical examination should include vital signs (ie, height, weight, and blood pressure) and visual acuity testing as well as a cardiovascular, pulmonary, abdominal, skin, genital (for males), and musculoskeletal examination. Further examination should be based on issues elicited during the history.

Cardiovascular examination

The cardiovascular examination requires an additional level of detail. Perform auscultation of the heart initially with the patient in both standing and supine position, and during various maneuvers (squat-to-stand, deep inspiration, or Valsalva's maneuver), as these maneuvers can clarify the type of murmur.

Any systolic murmur grade III/VI or louder, any murmur that disrupts normal heart sounds, any diastolic murmur, or any murmur that intensifies with the previously described maneuvers should be evaluated further through diagnostic

TABLE 3

The "90-second" musculoskeletal screening examination

Instruction	Observations
Stand facing examiner	Acromioclavicular joints: general habitus
Look at ceiling, floor, over both shoulders, touch ears to shoulder	Cervical spine motion
Shrug shoulders (resistance)	Trapezius strength
Abduct shoulders to 90° (resistance at 90°)	Deltoid strength
Full external rotation of arms	Shoulder motion
Flex and extend elbows	Elbow motion
Arms at sides, elbows at 90° flexed; pronate and supinate wrists	Elbow and wrist motion
Spread fingers; make fist	Hand and finger motion, strength, and deformities
Tighten (contract) quadriceps; quadriceps	Symmetry and knee effusions, ankle effusion relax
"Duck walk" away and towards examiner	Hip, knee, and ankle motions
Back to examiner	Shoulder symmetry; scoliosis
Knees straight, touch toes	Scoliosis, hip motion, hamstring tightness
Raise up on toes, heels	Calf symmetry, leg strength

studies (echocardiography) or consultation prior to participation. Sinus bradycardia and systolic murmurs are commonly found, occurring in over 50% and between 30% and 50% of athletes, respectively; they do not warrant further evaluation in the asymptomatic athlete.²⁶ Third and fourth heart sounds are also commonly found in asymptomatic athletes without underlying heart disease.^{26,27}

Noninvasive cardiac testing (eg, electrocardiography, echocardiography, or exercise stress testing) should not be a routine part of the screening preparticipation exam (SOR: **B**).⁷

These tests are not cost-effective in a population at relatively low risk for cardiac abnormalities and cannot consistently identify athletes at actual risk.²⁸⁻³² For example, a substantial minority of subjects (11%) were found to have a clinically significant increased ventricular wall thickness, which made clinical interpretation of the echocardiographic findings difficult in individual athletes.²⁸ Furthermore, some patients with hypertrophic cardiomyopathy are able to tolerate particularly intense athletic training and competition for many years, and even maintain high levels of achievement without incurring symp-

Advising students about rules and equipment may decrease mortality and morbidity more effectively than the exam

toms, disease progression, or sudden death.²⁹

Echocardiography and stress testing are the most commonly recommended diagnostic tests for patients with an abnormal cardiovascular history or examination. With the assistance of clinical information, echocardiography is able to distinguish the nonobstructive hypertrophic cardiomyopathy from the athletic heart syndrome.³³

Musculoskeletal examination

A screening musculoskeletal history and examination in combination can be used for asymptomatic athletes with no previous injuries (**Table 3**) (SOR: **A**).³⁴ An accurate history is able to detect over 90% of significant musculoskeletal injuries. The screening physical examination is 51% sensitive and 97% specific.³⁴ If the athlete has either a previous injury or other signs or symptoms (ie, pain; tenderness; asymmetries in muscle bulk, strength, or range of motion; any obvious deformity) detected by the general screening examination or history, the general screening should be supplemented with relevant elements of a site-specific examination.

Additional forms of musculoskeletal evaluation are often performed for athletes to determine their general state of flexibility and muscular strength. While various degrees of hyperlaxity, muscular tightness, weakness, asymmetry of strength or flexibility, poor endurance, and abnormal foot configuration may predispose an athlete to increased risk of injury during sports competition, studies have failed to demonstrate conclusively that injuries are prevented by interventions aimed at correcting such abnormalities.³⁵⁻³⁷

Role for lab tests?

Studies do not support the use of routine laboratory or other screening tests such as urinalysis,

complete blood count, chemistry profile, lipid profile, ferritin level, or spirometry as part of the exam (SOR: **B**).³⁸⁻⁴¹

DETERMINING CLEARANCE

Occasionally, an abnormality or condition is found that may limit an athlete's participation or predispose him or her to further injury. In these cases, the examining physician should review the following questions:⁵

1. Does the problem place the athlete at increased risk for injury?
2. Is another participant at risk for injury because of the problem?
3. Can the athlete safely participate with treatment (ie, medication, rehabilitation, bracing, or padding)?
4. Can limited participation be allowed while treatment is being completed?
5. If clearance is denied only for certain sports or sport categories, in what activities can the athlete safely participate?

Physicians should base clearance to participate in a particular sport on previously published guidelines, such as the recommendations by the American Academy of Pediatrics, the 26th Bethesda Conference, and the American Heart Association.^{7,43,44} Participation recommendations are based on the specific diagnosis, though multiple factors such as the classification of the sport and the specific health status of the athlete affect the decision.⁴⁴

APPROACH TO THE PATIENT

While current research demonstrates that the preparticipation physical examination has no effect on the overall morbidity and mortality rates in athletes, these exams may fulfill other objectives. Furthermore, no harmful effects of these examinations have been reported, and the exam has become institutionalized in the athletic and sports medicine community. As such, physicians should base their evaluation on the best available evidence using the standard form shown in "Preparticipation physical evaluation

for athletics.”⁶ (A copy of the Preparticipation Physical Evaluation form can be found at www.jfponline.com.) This may require that the physician work with local school systems to assure that they understand what constitutes an appropriate examination.

To assist future patient care decisions and research efforts, a standardized preparticipation physical examination with an associated form similar to the evaluation recommended by the Preparticipation Physical Evaluation Task Force should be uniformly implemented throughout the country. The use of consistent clearance criteria as recommended by the Preparticipation Physical Evaluation Task Force or the American Academy of Pediatrics (“Medical conditions and sports participation,” also available at www.jfponline.com) should be used, studied, and revised as needed.^{5,44}

In addition to the exam, physicians should consider exploring other aspects of sports participation to assist athletes in reducing the risk of injury. Rules, equipment, or other factors may have a greater effect on decreasing the mortality and morbidity associated with athletic participation. A marked decrease in cervical spine injuries occurred following the rule change in football banning deliberate “spearing”—the use of the top of the helmet as the initial point of contact in making a tackle.⁴¹

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