Athlete Age and Sports Physical Examination Findings

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Background. Interscholastic and intercollegiate athletes commonly visit physician offices to have sports preparticipation examinations (PPEs). Few data exist, however, to help determine the age range for which such examinations are reasonable. The purpose of this study was to determine the percentage of athletes with significant findings on sports PPEs among junior high school, high school, and college-age athletes.

Methods. Analyses were made of 937 consecutive PPEs that were performed by primary care physicians using a standardized form. Subjects were interscholastic athletes of junior high, high school, and college age. Significant findings were defined as those that resulted in any recommendation, ie, change in management, by the examining physician.

Results. The incidence of significant findings was 3.4% for the junior high school athletes, 15.4% for high school athletes, and 33.9% for college athletes ($P<.001$). The overall percentage of athletes disqualified from participating in any sport, which was 1.7%, did not differ significantly across age levels.

Conclusions. In this sample, college and high school athletes were much more likely than junior high school athletes to have significant findings on sports PPEs. These data cast uncertainty on the necessity of annual PPEs to screen athletes of junior high school age.

Key words. Sports preparticipation examinations; sports; sports medicine; age; age factors; family physicians; physical examination; sports clearance. (*J Fam Pract 1995; 40:370-375*)

It has been estimated that as many as 7 million high school athletes and a similar number of junior high school athletes undergo sports preparticipation examinations (PPEs) each year.[1] A much smaller number (approximately 360,000) of intercollegiate athletes may need medical clearance for competition in a given year (1993–1994 statistical data on file at the National Collegiate Athletic Association in Overland Park, Kansas; the National Junior College Athletic Association in Colorado Springs, Colorado; and the National Association of Intercollegiate Athletics in Tulsa, Oklahoma). Most of these athletes present to family physicians and pediatricians to have these examinations performed.

For an activity so prevalent, few data exist to help clinicians decide the age range for which these examinations are appropriate. It has been recommended that PPEs be done at the time of entry into sport, and at the beginning of junior high, high school, and college. An interim history form would be filled out in the intervening years and further examination performed only as indicated by the information on this form.[2]

In most of the United States, the periodicity of PPEs for high school athletes is determined by state law. Thirty-five states require annual examinations.[3] In our state, the Illinois High School Association requires annual PPEs. Legal recommendations for PPEs in junior high school athletes vary, but several schools in our area do not allow sports participation without a yearly examination. Most colleges also require their athletes to have annual examinations.

Such legal or school requirements determine practice patterns for most physicians engaged in this activity. However, a literature search revealed no data that demonstrated the yield of PPEs with respect to athlete age. The primary purpose of this study was to examine the number of significant findings in PPEs performed on athletes with respect to age. This information may help determine the age range for which sports preparticipation examinations are appropriate.

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Table 1. School Settings and Distribution of Schools and Students, by Level of Schooling

Level of Schooling	School Setting: Rural No. of Schools (Students)	Suburban No. of Schools (Students)	Urban No. of Schools (Students)
Junior high	0 (0)	4 (386)	0 (0)
High school	1 (72)	3 (209)	2 (96)
Junior college	0 (0)	1 (83)	0 (0)
4-year college*	0 (0)	0 (0)	1 (91)

*NCAA (National Collegiate Athletic Association) Division I university.

Methods

Completed standardized forms for 937 consecutive PPEs performed by primary care physicians were analyzed. The examining physicians consisted of eight family physicians, two internists, and one pediatrician. Three of the family practice physicians were residents. One of the internists was a sports medicine fellow. Subjects were athletes wishing to participate in extracurricular sports at several junior high schools (grades 6 through 8) and high schools (grades 9 through 12), and two colleges in Illinois during a 2-year period.

School settings (urban, suburban, and rural) are listed in Table 1. The male to female ratio, approximately 2 to 1, was fairly consistent across age groups. Ethnic and socioeconomic data were not specifically recorded, but the population was racially heterogeneous and most of the athletes were from middle-class to lower middle-class backgrounds.

The examination format varied somewhat, but most of the PPEs were performed as multiple-station screening physical examinations. In general, there were separate stations for vital signs, vision, history review, physical examination, and discussion of age-specific preventive issues. Most of the examinations were performed in the training room or nurse's office at the school. A few were conducted in physician offices.

The history portion of the PPE form used was designed to be concise and easy to fill out by athletes and their parents (Figure 1). Previous research has demonstrated that the overwhelming majority of findings that affect sports participation are identified in the process of taking a history.[4] The questions on this form specifically address historical factors[5] that might place athletes at risk from sports participation. All athletes under the age of 18 were given the form to take home before undergoing the PPE. Forms were completed by the athletes along with their parents in an effort to ensure greater accuracy.

The physical examination consisted of a multiple system clinical examination and several standardized tasks to evaluate functional range of motion for athletics. Active shoulder range of motion was assessed using the Apley scratch test, in which the athlete reaches over the head to touch the superior medial angle of the opposite scapula, then reaches behind the back to touch the inferior medial border of the opposite scapula.[6] Lower extremity range of motion was assessed by having the athlete squat and then "duck walk" while remaining in the squatting position.[7] If athletes had difficulty with any of these tasks, a more directed joint examination was performed.

Lumbar spine and hip range of motion were assessed by having the athletes bend forward and touch their toes. Those who were unable to touch their toes were placed supine with the hips and knees both flexed to 90°. If the examiner was unable to extend the athlete's knee within 20° of full extension from this position, hamstring tightness was diagnosed.[8]

In general, cardiac auscultation was performed with the athlete seated rather than in the traditional supine position. This position typically causes a systolic ejection murmur (a common benign finding in athletes) to become less prominent, whereas it intensifies the murmur of hypertrophic cardiomyopathy, a rare condition that is considered a predisposing factor in sudden death during athletic activities. Murmurs that either remained the same or decreased when the athlete was in a standing position were considered to be benign systolic ejection murmurs. Those that increased with standing would most likely have resulted in the athlete being referred for further diagnostic evaluation.

Athletes with a history of injury or illness had a more directed examination of the involved anatomic area. Decisions regarding recommendations and clearance were at the discretion of each individual examining physician.

Any finding identified on history or physical examination that resulted in a recommendation to the athlete from the examining physician was classified as significant. This definition was used because recommendations by physicians were the only mechanism by which a change in the management of individual athletes would have occurred. Thus, incidentally noted findings such as "benign systolic ejection murmur" and "history of fracture" that resulted in no further follow-up were not regarded as significant findings. Conversely, findings such as "tight hamstrings, stretching program recommended" and "hypertension, see primary physician" were considered significant. Significant findings were evaluated with respect to athlete age as determined by level of schooling.

Each athlete was assigned a clearance level for sports participation. There were five possible levels of clearance: (1) collision sports (eg, football); (2) contact sports (eg, basketball); (3) noncontact sports (eg, tennis); (4) notify

Name _____ Grade_____ Age_____ DOB_____ Sport(s)_____

Address_____ Phone_____ Parents_____

Date of Exam_____ Examining Doctor_____ Family Doctor_____ School _____

PLEASE GIVE DETAILS FOR ALL "YES" ANSWERS IN THE RIGHT MARGIN OR BELOW.

1) HAVE YOU EVER HAD ANY OF THESE PROBLEMS AFTER EXERCISING?

	YES	NO
passing out	___	___
severe lightheadedness/dizziness	___	___
coughing	___	___
wheezing	___	___
extreme shortness of breath	___	___

(2) INJURIES: HAVE YOU HAD:

	YES	NO
concussion/knocked out	___	___
neck pain/injury	___	___
back pain/injury	___	___
broken bone	___	___
joint injury	___	___
ligament/muscle injury	___	___
sprains/strains	___	___

(3) HAS ANYONE IN YOUR FAMILY (INCLUDING GRANDPARENTS, AUNTS, UNCLES, COUSINS) EVER DIED SUDDENLY BEFORE AGE 50? YES ___ NO ___

(4) DO YOU WORRY ABOUT YOUR WEIGHT OFTEN? YES ___ NO ___

(5) DO YOU AVOID EATING MEAT? YES ___ NO ___

(6) DO YOU AVOID EATING DAIRY FOODS? YES ___ NO ___

(7) ALLERGIES:_____ ☐ NONE

(8) HAVE YOU HAD MEDICAL PROBLEMS SUCH AS:

	YES	NO
heat stroke/heat exhaustion	___	___
diabetes	___	___
mononucleosis	___	___
bleeding problems	___	___
bruise easily	___	___
eye problems	___	___
absence of 1 kidney	___	___
absence of 1 testicle	___	___
hernia	___	___
seizures	___	___
bee sting allergy	___	___
menstrual problems	___	___

(9) LIST ANY MEDICATIONS YOU TAKE REGULARLY_____ ☐ NONE

(10) LIST ANY OTHER CHRONIC ILLNESSES OR MEDICAL PROBLEMS:_____ ☐ NONE

(11) LIST ANY HOSPITALIZATIONS YOU HAVE HAD IN THE RIGHT HAND MARGIN OR BELOW. ☐ NONE

THE ABOVE INFORMATION IS CORRECT _____ _____
signed: athlete parent

TO BE COMPLETED BY PHYSICIAN: LAB:_____

EXAM:

P_____BP_____HT_____WT_____GLASSES/CONTACTS_____PUPILS: R_____L VISION:R_____L_____

IF THERE IS A POSITIVE HISTORY OF JOINT INJURY, DESCRIBE EXAM:

	NL		NL
UPPER EXTR:ROM		HEART	
SYMMETRY		MURMUR?	
SPINE NECK		IF YES, IS THERE CHANGE WITH STANDING?	
SCOLIOSIS?			
LOWER EXTR:		LUNGS	
GAIT		SKIN	
SQUAT		ABDOMEN	
DUCK WALK		TESTICLES HERNIA	
ROM		OTHER	

FINDINGS/RECOMMENDATIONS_____

_____

____PREVENTIVE ISSUES ADDRESSED: ETOH, SMOKING, DRUGS (STEROIDS), SAFE SEX

____FEMALES: REGULAR PAP SMEAR, BREAST EXAM DISCUSSED

CLEARANCE: (CIRCLE A, B, OR C)

A - CLEARED FOR: COLLISION ____ CONTACT ____ NON-CONTACT ____ SPORTS

B - NOTIFY: FAMILY DOCTOR ____ COACH ____ PRIOR TO CLEARANCE

C - CLEARANCE DEFERRED DUE TO: _____

PHYSICIAN'S SIGNATURE_____

Figure 1. Sports preparticipation examination form used in the study.

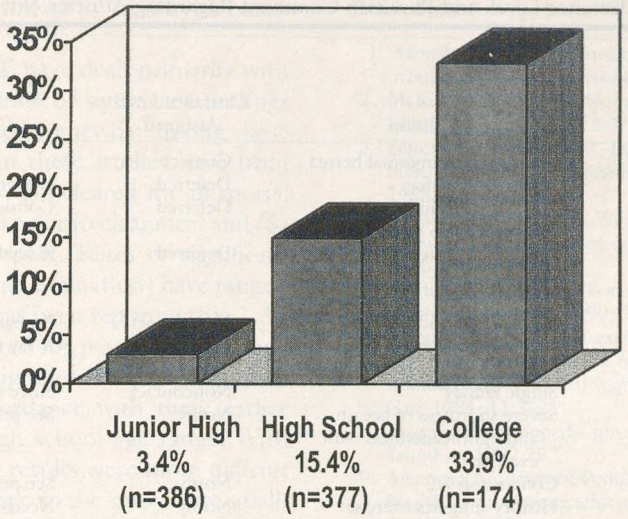

Figure 2. Percentage of athletes with significant findings on the sports preparticipation examination, by level of schooling.

family physician or coach prior to clearance; and (5) clearance deferred. Sports were classified in accordance with the American Academy of Pediatrics guidelines.[9] Clearance was also evaluated with respect to athlete age based on level of schooling, and all results were analyzed using the chi-square test.

Results

The percentages of athletes with significant findings were 3.4% (13/386) for junior high school athletes, 15.4% (58/377) for high school athletes, and 33.9% (59/174) for the college athletes, as shown in Figure 2. The differences in frequency of positive findings by age level were statistically significant ($P<.001$). The overall percentage of athletes with significant findings was 13.9% (130/937).

In the 130 athletes with findings that resulted in recommendations, certain conditions occurred with greater frequency. Forty-eight athletes had one of the following five conditions: tight hamstring muscles, ankle ligament laxity, patellofemoral arthralgia, tendinitis, and obesity (Table 2). Twenty-one athletes who were found to have tight hamstring muscles were advised to begin a stretching program. Eight athletes in whom ankle ligament laxity was noted received basic instruction regarding rehabilitation exercises, or advice about supportive ankle devices or taping, or both. The seven athletes who had patellofemoral arthralgia were advised to do exercises to strengthen the quadriceps, particularly the vastus medialis oblique. Rotator-cuff strengthening exercises were recommended to the seven athletes found to have tendinitis of either the biceps or supraspinatus tendons in the shoulder. Weight-loss strategies were discussed with the five athletes who were found to be obese.

All but 1.0% (4/386) of the junior high school athletes received the highest clearance level (clearance for collision sports). The corresponding percentages were 2.1% (8/377) for high school athletes and 2.3% (4/174) for the college athletes (Table 3). The differences in these frequencies across age levels were not statistically significant ($P>.05$). Only 16 of the 937 (1.7%) athletes failed to receive clearance for collision sports. Assignment of any

Table 2. Significant Findings Resulting in Recommendations from the Examining Physician

Findings	No. of Athletes
Tight hamstrings	21
Ankle laxity	8
Patellofemoral pain	7
Shoulder tendinitis	7
Obesity	5
Elevated blood pressure	4
History suggests exercise-induced bronchospasm	4
"Mildly winged scapula"	4
Poor visual acuity	4
Recent fracture	3
Recent ankle sprain	3
Knee laxity	3
History of heat exhaustion	3
Decreased shoulder range of motion	3

NOTE: Each of the following findings was noted in only one or two of the athletes examined: recent sutures, prior cardiac surgery, inguinal hernia, history of shoulder dislocation, back strain with range-of-motion limitation, recent hamstring strain, shin splints, achilles tendinitis, oligomenorrhea, decreased knee flexion, possible exercise-induced arrhythmia, recent acromioclavicular separation, knee pain, finger sprain, recent wrist sprain, recent finger dislocation, history of heat stroke, severely pronated right foot, type I diabetes mellitus, severe Osgood-Schlatter disease, recent anterior cruciate ligament reconstruction, foot pain (possible stress fracture), patellar tendinitis, iliotibial band syndrome, multiple concussions, and recent groin strain.

Table 3. Age Level, Condition, Clearance Level, and Physician Comment Regarding Athletes Not Cleared for Collision Sports

Age, by Level of Schooling	% Not Cleared for Collision Sports	Condition	Clearance Level Assigned	Comment by Examining Physician
College athletes (n=174)	2.3	Possible right inguinal hernia	Contact	
		Atrial septal defect	Deferred	Get prior records
		Probable shoulder dislocation 6 weeks ago	Deferred	Consider magnetic resonance imaging
		Possible fracture of 5th metatarsal	Deferred	X-ray foot
High school athletes (n=377)	2.1	Right winged scapula	Noncontact	Primary physician to decide about wrestling
		Possible left index finger fracture	Noncontact	X-ray finger
		Single kidney	Noncontact	Since surgery at age 3 weeks
		Severe shortness of breath and lightheadedness with exercise	Notify	See primary physician
		Concussion ×2	Notify	See primary physician
		History suggests exercise-induced arrhythmia	Notify	Needs treadmill
		Lightheaded with exercise	Deferred	Following neck and back injury
		Mitral valve prolapse with regurgitation	Deferred	
Junior high school athletes (n=386)	1.0	Scoliosis, mild	Notify	See primary physician
		Scoliosis, mild	Notify	See primary physician
		Abdominal pain	Notify	Workup in progress
		Right ankle sprain	Deferred	Two days ago
All age levels (N=937)	1.7			

clearance level other than collision was classified as a recommendation since it resulted in a change from the usual management of these athletes. Therefore, these 16 athletes were considered to have significant findings and were included in the data with respect to significant findings.

Discussion

These data lend support to the notion that older athletes, who in most instances have participated in sports over a longer time than younger athletes, are more likely to have suffered ill effects related to activity. The PPE is an ideal opportunity to identify these factors and modify them. Athletes of college age may be particularly likely to have positive findings on the PPE. Meticulous attention should be paid to the examinations of athletes at this level. In this sample of junior high school athletes, however, the PPE seldom revealed significant medical problems or injuries.

Replication of this study with greater numbers of athletes may be necessary before generalizable conclusions regarding the appropriate age range for PPEs can be definitively drawn. Nonetheless, we used a fairly liberal definition of "significant finding," and still the history and physical examination revealed few factors that resulted in any sort of intervention for the junior high school athletes. A more universal policy of waiting until high school before initiating PPEs may be worth consideration. It is estimated that approximately 7 million PPEs are performed annually on junior high school athletes.[1] Eliminating these examinations would result in substantial health care savings nationwide. If, for instance, an average of $20 per PPE is charged, the first-year savings would be $140 million.

Of course, the PPE can function as more than just an opportunity to assess for factors that may place an athlete at risk from sports participation.[10,11] These examinations can function as an ideal opening for discussion of adolescent health risk behaviors such as smoking, sexual activity, and alcohol and drug abuse (including abuse of anabolic steroids). Since we agree with this approach, we provided counseling on these topics to every athlete in this sample.

It is important to discuss these preventive issues with all adolescents. Others are currently recommending frequent health maintenance visits during early adolescence primarily to address these behaviors.[12,13] However, until these issues are addressed with adolescents on a more universal scale, there is probably no compelling reason to

single out junior high school athletes for health risk counseling during PPEs.

Other analyses of the PPE have dealt primarily with high school athletes. Definitions of significant findings and sports clearance have varied somewhat among these studies. In general, athletes in these studies have been categorized into three groups: (1) cleared for all sports, (2) further evaluation required prior to clearance, and (3) not cleared for at least one sport. Rates of significant findings (those requiring further evaluation) have ranged from 6.8% to 14.9%, while it has been reported that 1.3% to 3% of athletes are not cleared for participation in any sport.[1,14,15] With respect to significant findings, our results seem in reasonable accordance with these earlier studies, particularly in the high school age range. With respect to clearance level, our results were more difficult to characterize since the numbers in the study were small. However, the percentage of athletes not cleared for collision sports was quite low (1.7%), as in other studies.

It seems reasonable to base decisions about the age range for which sports PPEs are appropriate on available data rather than on legislative mandates, as has been done in the past. It is hoped that the results of this study will give clinicians a foundation on which to base these decisions.

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