Preparticipation Cardiovascular Screening for US Collegiate Student-Athletes

Glen C. Pfister, BS
James C. Puffer, MD
Barry J. Maron, MD

The occurrence of unexpected sudden death in student-athletes due to unsuspected cardiovascular disease is an uncommon but often highly visible event that has heightened public concern and that of the medical community. Indeed, such catastrophes have stimulated considerable interest in the role of preparticipation screening. In this regard, we previously analyzed the status of screening in US high schools and judged that process to be deficient. Because the status of preparticipation cardiovascular screening available to student-athletes in college is unresolved, we believe it is timely to evaluate the strengths and limitations of this process.

METHODS

We distributed survey questionnaires to the team physician or the athletic director or athletic trainer of the 1110 National Collegiate Athletic Association (NCAA) colleges and universities between 1995 and 1997. In these questionnaires, we solicited detailed information regarding the administration and scope of preparticipation screening, including credentials of team physicians and examiners, and the frequency and site of evaluations.

In a similar fashion, we contacted each institution by telephone to request the most recent version of the approved history and physical examination forms currently in use for preparticipation screening of varsity student-athletes. The content of these forms represents a guide to examiners and is the basis for screening at that institution. Those portions of the screening forms that were relevant to the cardiovascular system were analyzed and items pertaining to the history and physical examination were tabulated by one of us (G.C.P.) and compared with the 12 American Heart Association (AHA) 1996 consensus panel recommendations for preparticipation cardiovascular screening of athletes, which included the following: family history of premature sudden death or heart disease in surviving relatives; personal history of (3) heart murmur, (4) systemic hypertension, (5) excessive fatigue, (6) exertional syncope, (7) exertional chest pain, or (8) excessive exertional chest pain; and physical stigmata or family history of Marfan syndrome.

Conclusion The preparticipation screening process used by many US colleges and universities may have limited potential to detect (or raise the suspicion of) cardiovascular abnormalities capable of causing sudden death in competitive student-athletes.
exertional shortness of breath; physical examination for (9) heart murmur, (10) femoral pulses, or (11) stigmata of Marfan syndrome; and (12) blood pressure measurement. Proportions were compared with the \( \chi^2 \) test.

### RESULTS

#### Characteristics of the Screening Process

Of the 1110 NCAA institutions initially surveyed, 879 (79%) returned the questionnaire including 286 Division I (schools with larger undergraduate enrollments that provide athletic scholarships), 256 Division II (institutions generally intermediate with respect to enrollment and scholarships), and 337 Division III (schools with the smallest enrollments that do not offer athletic scholarships). A total of 855 (97%) of the 879 schools indicated that formal screening with a personal family history and physical examination was an absolute requirement prior to participation in varsity intercollegiate sports. Most institutions (713/879 [81%]) performed screening evaluations at 603 (85%) of the 713 campus sites administered by nonuniversity health care personnel, with the campus sites chosen by 625 (99%) of schools.

The content of the history and physical examination forms was compared with the \( \chi^2 \) test. For example, examination of the femoral pulses (ie, for detection of coarctation of the aorta) and recognition of Marfan stigmata were each included in only 9% to 52% of these forms: family history of Marfan syndrome, excessive fatigue, prior limitations placed on sports participation, excessive exertional shortness of breath, and exertional chest pain.

A designated team physician(s) was usually responsible for performing the evaluations at 603 (89%) of the 713 schools with screening on-campus, either alone or in association with nurse practitioners (n = 135) or athletic trainers (n = 244). Most of the team physicians were from Division III schools (49% and 72 [30%], respectively) and less common (29 [14%]) in Division I (P < .001).

### Preparticipation Screening Forms

The most recent versions of the screening history and physical examination forms were obtained from 625 institutions. Of these, 205 (33%) were from NCAA Division I schools, 176 (28%) were from Division II schools, and 244 (39%) were from Division III schools.

The content of the history and physical screening forms pertinent to the cardiovascular system are shown in the TABLE. Certain clinically relevant AHA-recommended items were included in only 9% to 52% of these forms: family history of Marfan syndrome, excessive fatigue, prior limitations placed on sports participation, excessive exertional shortness of breath, and exertional chest pain.

Approved physical examination forms also demonstrated important omissions. For example, examination of the femoral pulses (ie, for detection of coarctation of the aorta) and recognition of Marfan stigmata were each included in only 9% to 52% of the forms.

Forms arbitrarily regarded as adequate by containing at least 9 of the 12 AHA-recommended items were present for 163 schools (26%), including 10 institutions with 11 or 12 items (Figure). In contrast, forms arbitrarily judged to be inadequate with 4 or less AHA recommendations came from 150 schools (24%), including 46 with only 0 to 2 items. The remaining 312 schools (50%) used forms that were intermediate by virtue of addressing 5 to 8 AHA recommendations (Figure). Of note, inadequate forms were more frequent in NCAA Division II and Division III schools (49 [28%] and 72 [30%], respectively) and less common (29 [14%]) in Division I (P < .001).

### COMMENT

Sudden death due to cardiovascular disease in trained athletes is most common in high school and college-aged participants. High-intensity physical activity may act as a trigger to increase the risk of sudden death in predisposed athletes with underlying cardiovascular disease. These observations have raised awareness of pre-
PREPARTICIPATION CARDIOVASCULAR SCREENING FOR STUDENT-ATHLETES

participation screening in the lay public and physician community as a vehicle for detecting cardiovascular abnormalities responsible for these catastrophes, and as a stimulus for withdrawal of selected athletes from competition to reduce risk.

We previously assessed the preparicipation cardiovascular screening process in US high schools by analyzing approved history and physical examination forms as well as designated examiners in each state. In that study, 40% of states either had no screening requirement, no approved examination forms, or forms that were judged inadequate with respect to consensus panel recommendations.

With these observations as a premise, we believed that it was timely to analyze in a similar fashion preparicipation screening in US colleges and universities. We considered the history and physical forms developed by these institutions to constitute the designated guidelines for examiners and thereby represent their specific objectives of cardiovascular screening.

This study shows that, similar to high school athletes, collegiate student-athletes may be exposed to a flawed preparicipation cardiovascular screening process that reduces the reasonable expectation of detecting pertinent cardiovascular abnormalities in some athletes. When AHA consensus panel recommendations were used as the “gold standard” for comparison, about 25% of the NCAA schools were considered to have inadequate screening forms. Indeed, the forms of a substantial number of institutions omitted items that are crucial to the cardiovascular evaluation, such as exertional dyspnea and chest pain, prior limitation from competitive sports, excessive fatigue, or family history of Marfan syndrome.

Of the colleges surveyed, 85% used a designated team physician(s) as the approved examiner to perform preparicipation evaluations. Nevertheless, the majority (75%) of these team physicians were orthopedic surgeons, clinicians who are often not as familiar with cardiovascular evaluations as are primary care physicians or trained cardiovascular subspecialists. A substantial proportion of institutions surveyed also permit nurse practitioners and athletic trainers to perform preparicipation examinations, alone or in association with physicians; these observations emphasize the importance of establishing minimum standards of expertise for non-physician (and physician) clinicians performing screening examinations.

Nevertheless, when performed optimally, preparicipation screening with customary history and physical examination has the potential to identify cardiovascular abnormalities such as hypertrophic cardiomyopathy, Marfan syndrome, some cases of arrhythmogenic right ventricular dysplasia, dilated cardiomyopathy, and atherosclerotic coronary artery disease. Marfan syndrome and systemic hypertension are identifiable from physical examination, as are diseases with a systolic heart murmur (eg, aortic valvular stenosis and obstructive hypertrophic cardiomyopathy).

Schools in NCAA Division I, which generally have the largest intercollegiate sports programs, award athletic scholarships, and place a priority on athletic achievement, were more likely to have comprehensive screening evaluations than Division II and III schools, which have generally smaller enrollments and intercollegiate sports programs and are permitted no or limited numbers of athletic scholarships.

While it is customary for preparicipation screening in US colleges and universities to consist of only standard history and physical examination, noninvasive tests such as the 12-lead electrocardiogram and echocardiogram could increase the likelihood of identifying important cardiovascular abnormalities, particularly hypertrophic cardiomyopathy. However, such screening tests are costly and impractical for most schools, particularly when considering the infrequency of sudden cardiac death for student-athletes (about 1 per 200,000 per academic year).

Our observations should represent an impetus for change and improvement in the preparicipation cardiovascular screening process for college-aged athletes. We expect that improved screening would ultimately increase the potential for more frequent detection of certain cardiovascular lesions associated with sudden death in collegiate athletes.

REFERENCES