

# Brief Communication: Cardiovascular Screening Practices of Major North American Professional Sports Teams

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**Background:** Customary preparticipation screening strategies to detect heart disease in professional athletes have not been examined systematically.

**Objective:** To describe the current preparticipation cardiovascular screening process for professional athletes.

**Design:** Screening practices surveyed by questionnaire.

**Setting:** The 122 major professional sports teams in North America.

**Participants:** Athletic trainers and team physicians.

**Measurements:** League recommendations for history taking and physical examination and noninvasive testing were compared with screening recommendations from an American Heart Association consensus panel.

**Results:** All 122 teams have team physicians perform annual screening, including family and personal history taking (100%), physical examination (100%), and lipid panels (108 of 122 [89%]).

Diagnostic testing by using electrocardiography was substantially more common (112 of 122 [92%]) than exercise testing and stress echocardiography (21 of 122 [17%]) or echocardiography (16 of 122 [13%]). League recommendations for history taking and physical examination were most complete for Major League Baseball and the National Hockey League, meeting 10 of 12 and 8 of 12 American Heart Association recommendations, respectively. The most comprehensive cardiovascular screening using echocardiography is confined to selected, elite professional basketball players.

**Limitations:** Data were self-reported by team representatives.

**Conclusions:** A variety of nonstandardized preparticipation screening strategies for the detection of cardiovascular disease, varying considerably in scope, constitute customary practice among professional sports teams.

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Professional athletes represent the pinnacle of sports achievement and excellence. Sudden unexpected deaths in such individuals are particularly tragic and counterintuitive (1–3). Recently, a number of elite professional basketball and football players have experienced cardiac events or died suddenly, attracting high public and media visibility (4–7). Therefore, it is important to define the most effective screening methods for detecting the diseases responsible for sudden death in young athletes, such as hypertrophic cardiomyopathy, coronary artery anomalies, myocarditis, and atherosclerotic coronary artery disease (2, 3, 8–15). Researchers have found screening strategies for high school and college competitive sports programs to be lacking in respect to the American Heart Association (AHA) expert consensus panel recommendations (Table 1) (10, 16, 17). However, customary preparticipation cardiovascular screening practices have not been systematically assessed in professional athletes. Therefore, it is timely to describe the current strategies for such screening in the professional athletic leagues of North America.

## METHODS

### Team Questionnaires

Surveys were mailed to the athletic trainers, team physicians, or both for the 122 teams competing in the 4 major men's professional sports leagues: Major League Baseball (MLB) ( $n = 30$ ), National Hockey League (NHL) ( $n = 30$ ), National Basketball Association (NBA) ( $n = 30$ ), and National Football League (NFL) ( $n = 32$ ). Team representatives completed questionnaires that solic-

ited detailed information about preparticipation cardiovascular screening practices. Data were assembled in 2005. Representatives from each of the 122 teams completed more than 95% of each questionnaire.

### League-Recommended Screening Strategies

We compared personal and family history taking and physical examination recommendations from the league offices of MLB, the NHL, and the NFL, usually established as part of the collective bargaining agreements between the players' unions and teams, with the 12 AHA recommendations (10) (Table 1). The NBA does not issue such screening recommendations.

### Predraft League Screening

We analyzed the process by which the NBA and NFL evaluate new players projected to be the most talented each spring, just before formal draft selection. Forms used in this process were also compared with AHA recommendations (10).

## RESULTS

### Team Screening Strategies

#### General Guidelines

All 122 professional teams completed the submitted questionnaire, which solicited information about screening

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**Context**

What types of screening strategies do sports teams use to detect heart disease in professional athletes?

**Contribution**

This survey of practices of 122 professional sports teams in North America found that team physicians always perform history taking and physical examinations, usually perform electrocardiography (92%) and lipid panels (89%), and infrequently perform exercise testing (17%) and echocardiography (13%). League recommendations about the content of the history and physical examinations varied among sports leagues.

**Cautions**

Data were self-reported by team representatives. Pros and cons of screening were not formally evaluated.

—The Editors

practices conducted by team physicians. Comprehensive personal and family history taking and physical examination were either an absolute requirement (115 of 122 [94%]) or a recommendation (7 of 122 [6%]). Screening examinations in some form were reported to have been team practice over 1 to 40 years (mean, 15 years).

Cardiovascular screening is repeated on an annual basis by 118 (97%) teams and is performed only in the first year of participation by the remaining 4 (3%) teams. Examinations are routinely conducted by each team before each season. In addition, they were conducted as part of negotiations for new players for 50 (41%) teams or at the end of the season for 7 (6%) teams.

Family practice or internal medicine physicians performed the screening examinations for 120 (98%) of the teams, and surgeons performed the examinations for the remaining 2 (2%) teams. Cardiovascular specialists participated in the screening process for 37 teams (30%).

**Components of Screening**

All 122 teams frequently assessed coronary risk factors, including blood pressure, lipid panels, blood glucose levels, and history taking for tobacco use (Table 2). Diagnostic testing with 12-lead electrocardiography (ECG) was common (112 of 122 [92%]), but routine echocardiography (16 of 122 [13%]), exercise testing (12 of 122 [10%]), and stress echocardiography (9 of 122 [7%]) were performed less frequently (Table 2). However, teams selectively performed echocardiography when clinically warranted.

**League-Recommended Screening Strategies**

Screening recommendations, which serve to guide physician examiners, include physical examination, history taking, or both and are issued by the league offices in 3 of the 4 professional sports leagues: MLB, the NHL, and the NFL (Figure). Major League Baseball offers screening

guidelines (designed for league entry) for history taking and physical examination, meeting 10 of 12 AHA screening recommendations. It also recommends ECG, lipid profile, and glucose tests. Unlike the other 3 leagues, MLB has a separate form for interval history taking in subsequent years.

The NHL recommends history taking and physical examination, meeting 8 of 12 AHA recommendations, but offers no guidelines for specific testing. The NFL recommends limited history taking and physical examination and ECG, chest radiography, lipid profile, and glucose tests but meets only 3 of 12 AHA recommendations. The NBA provides no standard league-wide recommendations for screening.

**Predraft League Screening**

Screening just before the annual league-entry draft is systematically practiced by the NBA and NFL. Both leagues offer medical evaluations at designated sites to those potential participants judged most elite and likely to be drafted. In the NFL, 380 potential participants undergo history taking and physical examination, 12-lead ECG, chest radiography, and laboratory tests, including lipid panel and blood glucose tests. Echocardiography and exercise tests are performed selectively. In the NBA, 80 potential participants are evaluated by history taking and physical examination, 12 lead-ECG, echocardiography, chest radiography, ECG, exercise testing, and lipid profile.

The NFL and NBA predraft history taking and physical examination forms and guides for physician examiners meet 7 of 12 and 9 of 12 AHA recommendations, respectively (Figure).

**Table 1. The 12-Element American Heart Association Recommendations for Preparticipation Screening of Competitive Athletes\***

**Medical history†**

- Personal history
  - Exertional chest pain or discomfort
  - Syncope or near-syncope
  - Excessive exertional and otherwise unexplained dyspnea
  - Fatigue associated with exercise
  - Prior recognition of a heart murmur
  - Elevated systemic blood pressure
- Family history
  - Premature death (sudden or otherwise) before age 50 y related to heart disease in 1 or more relatives
  - Disability from heart disease in a close relative <50 y of age
  - Specific knowledge of certain cardiac conditions in family members

**Physical examination**

- Heart murmur‡
- Femoral pulses to exclude aortic coarctation
- Physical stigmata of Marfan syndrome
- Brachial artery blood pressure (sitting position)

\* Based on reference 10.

† Parental verification is recommended for high school and middle school athletes.

‡ Auscultation should be performed in supine and standing positions to identify, in particular, murmurs of dynamic left ventricular outflow tract obstruction.

**Table 2. Annual Individual Team Screening Practices for 122 Professional Teams\***

Component	MLB, n (%)	NHL, n (%)	NFL, n (%)	NBA, n (%)	Total, n (%)
Personal history	30 (100)	30 (100)	32 (100)	30 (100)	122 (100)
Family history	30 (100)	30 (100)	32 (100)	30 (100)	122 (100)
Tobacco use	30 (100)	28 (93)	32 (100)	29 (97)	119 (98)
Nutritional supplement use	28 (93)	27 (90)	28 (88)	28 (93)	111 (91)
Physical examination	30 (100)	30 (100)	32 (100)	30 (100)	122 (100)
Blood pressure	30 (100)	30 (100)	32 (100)	30 (100)	122 (100)
12-lead ECG	28 (93)	24 (80)	32 (100)	28 (93)	112 (92)
Lipid panel†	29 (97)	22 (73)	29 (91)	28 (93)	108 (89)
Echocardiography‡	4 (13)	2 (7)	2 (6)	8 (27)	16 (13)
Chest radiography	15 (50)	11 (37)	27 (84)	18 (60)	71 (58)
Blood glucose	23 (77)	22 (73)	32 (100)	25 (83)	102 (84)
ECG exercise test§	1 (3)	4 (13)	0 (0)	7 (23)	12 (10)
Stress echocardiography	0 (0)	0 (0)	1 (3)	8 (27)	9 (7)

\* Values are expressed as percentages of professional teams reporting a particular screening practice. ECG = electrocardiography; MLB = Major League Baseball; NBA = National Basketball Association; NFL = National Football League; NHL = National Hockey League.

† Total cholesterol or complete lipid profiles, including cholesterol, low- and high-density lipoproteins, and triglycerides.

‡ Tabulated for echocardiographic examinations obtained on a routine basis; other teams may perform echocardiography if clinically warranted because of abnormal clinical findings.

§ Standard treadmill exercise testing; 3 NHL teams performed metabolic exercise testing with measurement of maximum oxygen consumption.

## DISCUSSION

Preparticipation screening is customary among North American professional sports teams. We identified a diverse array of screening strategies in professional sports, demonstrating variability among teams and among the 4 major sports leagues.

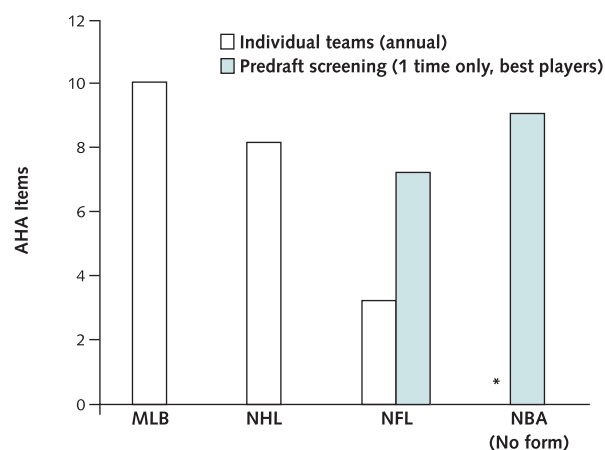
Although all 122 professional teams perform cardiovascular screening, we found history taking and physical examination according to league recommendations most complete for athletes in MLB and the NHL. The most comprehensive and systematic screening with noninvasive testing takes place in the NBA and NFL, although screening is largely confined to the most elite players. A lack of standardization in the screening process for professional athletes is in part due to individual team physicians, who may or may not follow the specific recommendations issued by the league offices (with the exception of the NBA) and who frequently develop their own strategies. For example, MLB teams routinely follow league recommendations for history taking but infrequently use the guidelines for physical examination (and interval history taking).

Preparticipation screening of professional athletes differs in several important respects from customary screening for high school and college athletes (16, 17). Professional athletes routinely undergo examinations, usually annually, by team physicians predominantly trained in family practice and internal medicine. In contrast, high school examinations are frequently performed by nonphysicians (17). Twenty-five percent of U.S. colleges (16) and 40% of the states (for high school screening) (17) report no substantive screening requirement or inadequate guideline questionnaires compared with AHA recommendations (10).

However, the most important distinction between screening programs offered to athletes in professional sports and those in high school and college is that professional sports leagues frequently use noninvasive diagnostic

testing, most commonly 12-lead ECG but also selective echocardiography and exercise ECGs. Such testing is virtually absent in high school and college screening (16, 17). Furthermore, professional teams rigorously test for coronary artery risk factors with lipid panels (and sometimes exercise testing), even though most of the athletes are younger than 35 years of age (1–3, 18–21). Screening recommendations previously proposed for older athletes may apply to this subset of professional athletes (18).

**Figure. Analysis of American Heart Association (AHA) history and physical examination items identified on league-recommended screening forms.**



History and physical examination recommendations promoted by the professional sports leagues serving as guides to the physician examiners. Individual components are compared with 12 AHA recommendations. Data are also analyzed for pre-draft screening of the most elite National Basketball Association (NBA) ( $n = 80$ ) and National Football League (NFL) ( $n = 380$ ) players. MLB = Major League Baseball; NHL = National Hockey League. \*NBA does not provide league recommendations to teams for history and physical examination.

Despite the strengths of professional athlete screening, there is opportunity for improvement. First, it is important to systematically implement annual history taking and physical examination forms encompassing all 12 AHA recommendations (10). Second, a more comprehensive, although potentially more expensive, strategy is to provide initial screening with echocardiography and ECG for all players. At the present time, routine echocardiography is part of professional athlete screening only during predraft examinations for the most elite players before entry into the NBA (22). Screening with echocardiography might allow examiners to identify such unsuspected conditions as hypertrophic and dilated cardiomyopathy, mitral valve prolapse, and aortic root dilatation, as recently demonstrated in 3 NBA players (1–3, 9, 23). However, it is unclear how often such screening would result in false-negative or false-positive results and the need for additional testing. Triggered largely by the recent sudden death of a player, the NBA announced a preliminary plan to extend routine systematic screening with echocardiography (as well as other noninvasive testing) to all its athletes beginning in 2006 (4, 24).

Currently, most professional teams routinely test their athletes by using ECG, a strategy similar to that routinely used in the Italian national preparticipation screening program for competitive athletes (12, 25). The Italian system has proved efficacious in diagnosing hypertrophic cardiomyopathy and has probably prevented sudden deaths by virtue of mandatory disqualification from sports (12, 25). The results of ECG performed as part of screening can be expected to identify ion channelopathies and may lead to the diagnosis of arrhythmogenic right ventricular cardiomyopathy, myocarditis, and atherosclerotic coronary artery disease (1, 3, 9, 26). Although the 4 professional athletic leagues expend considerable effort in designing and performing preparticipation screening strategies, it is uncertain how individual professional teams interpret and process test results to resolve diagnoses or arrive at disqualification decisions (8, 13).

The detection of heart disease in professional athletes appears to be uncommon, particularly given the large number of professional athletes (>4000). In our survey, only 20 athletes over a span of 15 years were reportedly removed from competition because of cardiac disease (most commonly Wolff–Parkinson–White syndrome and hypertrophic cardiomyopathy). Nevertheless, 7% (8 of 122) of teams reported a sudden death, and media reports document 7 athletes on professional team rosters experiencing sudden death events in the past 6 years (6, 7, 27–30). This suggests that as many as 1 of 3500 professional sports team athletes may experience a sudden death event each year, a rate much higher than that reported for high school athletes or marathon runners (31–33). A limitation of our analysis is that our data were self-reported (without independent verification) by team representatives.

To our knowledge, this paper is the first comprehen-

sive analysis of the preparticipation cardiovascular screening process used in professional sports. Strategies used by the 122 professional teams surveyed varied considerably with respect to comprehensiveness and potential effectiveness. The strategies lacked coordination among involved parties, and initiatives from team physicians and league offices often overlapped. We believe that more standardized preparticipation screening, including targeted history taking and physical examination as well as ECG and strong consideration for echocardiography at league entry, would be a reasonable goal to enhance the safety of professional athletes.

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