Should Preparticipation Cardiovascular Screening of Athletes Include ECG?

No: There Is Not Enough Evidence to Support Including ECG in the Preparticipation Sports Evaluation

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This is one in a series of pro/con editorials discussing controversial issues in family medicine.

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Screening athletes for cardiovascular disease and restricting athletic competition in those deemed at risk of sudden cardiac death (SCD) remain controversial. Several countries, including Italy and Israel, require cardiac screening with electrocardiography (ECG) in athletes.[1,2] In the United States, preparticipation cardiovascular screening does not routinely include ECG.[3,4] However, the evidence is insufficient to resolve the issue. The rate of SCD on U.S. athletic fields is not known, and no randomized controlled trials have evaluated the usefulness of screening and athletic restriction. Any successful screening strategy depends on sufficiently high prevalence of the condition in the population, testing that is adequately sensitive and specific, and an intervention that unequivocally provides net benefit. Currently, inclusion of ECG in the preparticipation sports evaluation and athletic restriction in those found to be at risk of SCD do not meet the standards of evidence required for implementation.

SCD is rare in athletes 12 to 25 years of age. Although the precise rate in the United States is not known, an analysis of SCD in young athletes in Minnesota from 1985 to 2007 found that the rate was 1.06 deaths per 100,000 persons per year.[4] These results are consistent with rates in other countries.[2,5] Only one study supports the notion that there is a higher incidence of SCD in athletes compared with the general population.[6] In Padua, Italy, the rate of SCD from 1979 to 1999 was 2.3 per 100,000 persons per year in athletes compared with 0.9 per 100,000 persons per year in nonathletes ($P < .0001$).[6] In contrast, the rate of SCD in Denmark was found to be higher among nonathletes (3.76 per 100,000 persons per year vs. 1.2 per 100,000 persons per year in athletes).[5] Data supporting the opinion that athletes should be selectively screened because of a higher rate of SCD are insufficient to justify preparticipation ECG.

The best available data indicate that preparticipation cardiovascular screening with ECG would result in an unacceptably high number of false-positive results. The combination of patient history, physical examination, and ECG has a reported sensitivity of 91% and specificity of 90% for detecting cardiac abnormalities in young athletes.[7] Following the logic of Bayesian law, a low incidence of SCD combined with testing that lacks sufficient specificity leads to a high number of false-positive results. In athletes, distinguishing normal ECG findings from abnormal ones is challenging. Training causes morphologic and physiologic changes—commonly referred to as the athlete's heart—that result in ECG changes that are difficult to distinguish from those associated with cardiovascular conditions that predispose a person to SCD. Many athletes have physiologic increases in QRS voltage, mild right or left axis deviation, and early repolarization that might erroneously suggest underlying cardiovascular disease.[8] Despite publication of athlete-specific ECG criteria by the European Society of Cardiology,[8] the rate of false-positive findings remains high. These false-positive findings can lead to unnecessary restriction of athletic activity and multiple adverse effects of additional testing.

Evidence that abnormal ECG findings lead to improved outcomes is limited to data from a single study.[1] In Italy, mandatory preparticipation screening of young athletes began in 1982. The rate of SCD decreased from 4.19 per 100,000 persons per year during the prescreening period (1979 to 1981) to 0.87 per 100,000 persons per year in the late screening period (1993 to 2004). However, the prescreening period was relatively short and contained an anomalously high SCD rate due to statistical variation. In contrast, an Israeli study that used a significantly longer prescreening period showed no difference in the rate of SCD after mandatory preparticipation screening with ECG was established (2.54 per 100,000 persons per year in the 12 years before screening began vs. 2.66 per ▶

100,000 persons per year in the 12 years afterward).[2] If the Israeli study had evaluated only the two years before screening was initiated (as did the Italian study), the investigators would have incorrectly reached the same conclusion.[2]

Although there are many reasons to conduct preparticipation sports examinations, there is insufficient evidence to support cardiac screening with ECG. Given the low prevalence of SCD, imprecise screening techniques available, and absence of highly effective interventions, current practices do not meet the standards of evidence necessary to implement an effective screening program. A consensus statement from the American Heart Association supports the exclusion of ECG from the preparticipation sports evaluation, based on a systematic analysis of all available relevant data.[3]

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REFERENCES

1. Corrado D, Basso C, Pavei A, Michieli P, Schiavon M, Thiene G. Trends in sudden cardiovascular death in young competitive athletes after implementation of a preparticipation screening program. *JAMA*. 2006;296(13):1593-1601.
2. Steinvil A, Chundadze T, Zeltser D, et al. Mandatory electrocardiographic screening of athletes to reduce their risk for sudden death: proven fact or wishful thinking? *J Am Coll Cardiol.* 2011;57(11):1291-1296.
3. Maron BJ, Friedman RA, Kligfield P, et al. Assessment of the 12-lead electrocardiogram as a screening test for detection of cardiovascular disease in healthy general populations of young people (12-25 years of age): a scientific statement from the American Heart Association and the American College of Cardiology. *J Am Coll Cardiol.* 2014;64(14):1479-1514.
4. Maron BJ, Haas TS, Doerer JJ, Thompson PD, Hodges JS. Comparison of U.S. and Italian experiences with sudden cardiac deaths in young competitive athletes and implications for preparticipation screening strategies. *Am J Cardiol.* 2009;104(2):276-280.
5. Holst AG, Winkel BG, Theilade J, et al. Incidence and etiology of sports-related sudden cardiac death in Denmark—implications for preparticipation screening. *Heart Rhythm.* 2010;7(10):1365-1371.
6. Corrado D, Basso C, Rizzoli G, Schiavon M, Thiene G. Does sports activity enhance the risk of sudden death in adolescents and young adults? *J Am Coll Cardiol.* 2003;42(11):1959-1963.
7. Weiner RB, Hutter AM, Wang F, et al. Performance of the 2010 European Society of Cardiology criteria for ECG interpretation in athletes. *Heart.* 2011;97(19):1573-1577.
8. Corrado D, Pelliccia A, Heidbuchel H, et al.; Section of Sports Cardiology, European Association of Cardiovascular Prevention and Rehabilitation. Recommendations for interpretation of 12-lead electrocardiogram in the athlete [published correction appears in *Eur Heart J.* 2010;31(3):379]. *Eur Heart J.* 2010;31(2):243-259. ■