Journal of the American College of Cardiology
© 2013 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 62, No. 14, 2013
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2013.05.080

Incidence of Sudden Cardiac Death in Minnesota High School Athletes 1993–2012 Screened With a Standardized Pre-Participation Evaluation

William O. Roberts, MD, MS, Steven D. Stovitz, MD, MS
Minneapolis, Minnesota

Objectives This study sought to determine the incidence of sudden cardiac death (SCD) during Minnesota State High School League (MSHSL) games and practices for high school (HS) athletes (12 to 19 years of age, with most age 15 to 18 years of age) using a uniform statewide pre-participation health screening examination (PPE) form every 3 years on a defined population across 19 academic years.

Background Adding electrocardiographic screening is being considered by some to reduce cardiac death rates in athletes, but the death rates in defined groups screened by the current U.S. PPE recommendations are unknown.

Methods MSHSL participation records were surveyed to determine the number of unduplicated athletes for 1993/1994 through 2011/2012 academic years, and catastrophic insurance records were used to find cardiac deaths.

Results There were 4 SCDs (2 cross country, 1 basketball, 1 wrestling), all male, during practice or games in 1,666,509 unduplicated athletes participating in ≥1 sports. The incidence of SCD in athletes screened every 3 years with a history and physical during MSHSL activities is 0.24 per 100,000 athlete-years over 19 years and 0.11 per 100,000 athlete-years over the past decade.

Conclusions The incidence of SCD in athletes screened every 3 years with standard PPE during MSHSL activities is 0.24 per 100,000 athlete-years in 19 academic years. This incidence is much lower than that observed in studies of Division 1 National Collegiate Athletic Association and Italian athletes (ages 18 to 25 and mean age 24 years, respectively). Our data do not warrant screening HS athletes with electrocardiography to prevent SCD episodes. The decision to screen athletes with electrocardiography should consider age, training intensity, and genetic predisposition.
(J Am Coll Cardiol 2013;62:1298–301) © 2013 by the American College of Cardiology Foundation

As summarized by the Working Group of the National Heart, Lung, and Blood Institute (1), there is an active debate in the United States over the issue of cardiovascular screening of young people, including athletes and nonathletes, to prevent sudden cardiac death (SCD). Much of the debate hinges on the rate of SCD in the population of interest. Specifically, for young athletes, if the rate in the U.S. high school (HS) athletes equaled or exceeded that reported in Italy (i.e., 3.6/100,000 athlete-years) (2), then some authorities might suggest that the benefits of electrocardiographic screening outweigh the risks. Many issues affect the decision, such as the predictive value of specific tests (e.g., electrocardiography) for SCD and the costs, financial and otherwise, to evaluate athletes who test positive. A recent study of National Collegiate Athletic Association (NCAA) athletes in the United States reported an incidence of SCD ranging from 1.05 to 3.45 per 100,000 athlete-years (Division 3 and 1 athletes, respectively), but no autopsies were performed and the cause of death was not verified (3).

See page 1302

The Minnesota State High School League (MSHSL) governs interscholastic activities in the state and is a member of the National Federation of High Schools. In the late 1980s, the MSHSL Sports Medicine Advisory Committee developed a standardized sports pre-participation history and physical evaluation (PPE) form for medical providers to clear

From the Department of Family Medicine and Community Health, University of Minnesota, Minneapolis, Minnesota. Both authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received March 24, 2013; revised manuscript received May 16, 2013, accepted May 28, 2013.

HS athletes for participation. The form is reviewed and updated annually by the Sports Medicine Advisory committee. In 1992, it was revised to conform to the recommendations of the Preparticipation Physical Examination Monograph, 1st Edition (4), and the form has been updated with each monograph edition and intervening PPE literature like the American Heart Association (AHA) cardiovascular pre-participation recommendations. The current form is based on the Preparticipation Physical Evaluation Monograph (4th Edition) (5), and AHA cardiovascular PPE recommendations (6).

In 1993, the MSHSL began to record individual athlete-years, in addition to the cumulative sports season participation that is reported annually to the National Federation of High Schools. The MSHSL requires that each athlete have catastrophic incident insurance, and the policy provides payment for sports-related deaths that occur during MSHSL games and practices. Payments are an accurate reflection of deaths that occur during MSHSL activities, and the numerator and denominator are concordant with the screened population at risk.

The purpose of this study was to determine the incidence of SCD during MSHSL games and practices for HS athletes (age range 12 to 19 years with most age 15 to 18 years) screened every 3 years with a standardized statewide PPE form that currently includes all components of the 2007 AHA cardiovascular PPE recommendations (6) using actual unduplicated athlete numbers.

Methods

This was a retrospective evaluation of MSHSL records for each academic year from 1993/1994 through 2011/2012. Because many athletes participated in >1 sport, we first determined the total number of athlete-seasons and unduplicated athletes. The unduplicated athlete records did not include specifics for sex or age. The catastrophic insurance (required for all MSHSL athletes) records were used to find cardiac deaths that occurred during HS-related practice or games. All deaths that occur during MSHSL sports practices and games are reported for insurance purposes, and events not associated with MSHSL activities do not enter the reporting system. Incidence rate was calculated by dividing the number of SCDs by the number of (unduplicated) athlete-years. This study was considered de-identified data by the University of Minnesota Institutional Review Board.

Abbreviations and Acronyms

AHA = American Heart Association
ECG = electrocardiogram
HS = high school
MSHSL = Minnesota State High School League
NCAA = National Collegiate Athletic Association
PPE = pre-participation health screening examination
SCD = sudden cardiac death

Results

Over 19 academic-years (from 1993/1994 through 2011/2012), there were 3,925,512 athlete-seasons, 2,085,366 boys and 1,739,168 girls. There were 1,666,509 unduplicated athletes participating in ≥1 sports per academic-year (2.35 sports seasons/athlete/academic-year). Four SCDs occurred during practice or games, all in males (2 cross country, 1993/1994 and 2002/2003; 1 basketball, 1995/1996; 1 wrestling, 2001/2002). Thus, there were 0.24 deaths/100,000 athlete-years (Table 1).

Discussion

This study, analyzing data from MSHSL student athletes screened every 3 years with a standardized PPE form, reveals a very low incidence of SCD during HS sports competitions and practices. The incidence of SCD in the MSHSL athlete is substantially lower than that in other studies (e.g., Italy, especially in their pre-electrocardiography years [2]) and NCAA college-age athletes, especially those of African-American descent, who were screened with only history and physical evaluation (3). Of importance, the subjects in the Italian study (average age, 24 years; range, 12 to 35 years) and

Table 1 Incidence of SCD in MSHSL Athletes Compared With Italian and NCAA Rates

	AY	No. of Cardiac Deaths	Incidence (/100,000 AY)	Relative Risk (Index MSHSL SCD Rate 1993–2012)
MSHSL 2003–2012	917,069	1	0.11	0.45
MSHSL 1993–2012	1,666,509	4	0.24	1.0
Italian 2001–2004 (2)	NA	2	0.43	1.8
Italian 1979–2004 (2)	2,938,730 (estimated)	55	1.90	7.9
Division 3 NCAA (3)	760,258	8	1.05	4.4
Division 2 NCAA (3)	424,572	10	2.38	9.9
Division 1 NCAA (3)	788,023	27	3.45	14.3
Italian pre-electrocardiography screening (1979–1981) (2)	NA	NA	3.60	15.0
NCAA black athletes (3)	NA	NA	8.33	34.7

AY = athlete-years; MSHSL = Minnesota State High School League; NA = not available; NCAA = National Collegiate Athletic Association; SCD = sudden cardiac death.