Sudden Death in Athletes: Is Screening Justified?

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Disclosure Statement of Financial Interest

- I have no disclosures related to this talk besides:

- I bike (to work) 7.5 KM x2 x4/week
  run ~30 km/week
  swim ~4 km/week
Pheidippides
In a perfect world, a randomized study of preparticipation screening should be conducted, but the scale required is extremely large.

As a consequence, the evidence regarding the efficacy of preparticipation screening is based on observational studies.
Problems with the SrSCD studies:

1. Are all cases/events reported? (numerator)

2. What are the population of competitive athletes (denominator)
Methods of assessment of incidence rates

• The incidence of sports related sudden cardiac death have been assessed in 3 ways:

• Retrospectively:
  • By identification through media search (Italy, US and Israel)
  • By identification through death certificates and autopsy (DK and US)

• Retrospectively and Prospectively:
  • By prospective registries (Italy and US)
Definition of Sports related SCD

- SrSCD may be defined as nontraumatic SCD occurring during or within 1 hour after moderate-to high-intensity exercise in a competitive athlete.
The Danish National Patient Register

Information on all hospitalizations in Denmark since 1977

The Danish Register of Medicinal Product Statistics

All claimed prescriptions from Danish pharmacies since 1995

The Danish Causes of Death Register and death certificates

Immediate, contributory, and underlying causes of death
Flowchart of the process used to identify SrSCD.

SCD = sudden cardiac death; SrSCD = sports related sudden cardiac death.
# Cases of sports-related sudden death in Denmark (2000 to 2006)

<table>
<thead>
<tr>
<th>Age at death</th>
<th>Sport</th>
<th>Sport arena</th>
<th>Witnessed</th>
<th>Autopsy results</th>
<th>Prodromal symptoms</th>
<th>Antecedent symptoms</th>
<th>Body weight (kg)</th>
<th>Heart weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Running</td>
<td>Yes</td>
<td>Yes</td>
<td>CCAA</td>
<td>None</td>
<td>Chest pain, no relation to exercise</td>
<td>72</td>
<td>454</td>
</tr>
<tr>
<td>17</td>
<td>Soccer</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>Dyspnea, treated as asthma</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>Running</td>
<td>No</td>
<td>No</td>
<td>ARVC</td>
<td>None</td>
<td>None</td>
<td>70</td>
<td>360</td>
</tr>
<tr>
<td>18</td>
<td>Soccer</td>
<td>Yes</td>
<td>Yes</td>
<td>ARVC</td>
<td>None</td>
<td>None</td>
<td>77</td>
<td>500</td>
</tr>
<tr>
<td>26</td>
<td>Soccer</td>
<td>Yes</td>
<td>Yes</td>
<td>Sarcoidosis</td>
<td>None</td>
<td>None</td>
<td>83</td>
<td>500</td>
</tr>
<tr>
<td>27</td>
<td>Running</td>
<td>Yes</td>
<td>Yes</td>
<td>SUD</td>
<td>None</td>
<td>None</td>
<td>82</td>
<td>395</td>
</tr>
<tr>
<td>27</td>
<td>Soccer</td>
<td>Yes</td>
<td>Yes</td>
<td>SUD</td>
<td>None</td>
<td>Dyspnea, treated as asthma</td>
<td>76</td>
<td>332</td>
</tr>
<tr>
<td>28</td>
<td>Cycling</td>
<td>No</td>
<td>Yes</td>
<td>ARVC</td>
<td>None</td>
<td>Exercise-related syncope</td>
<td>81</td>
<td>535</td>
</tr>
<tr>
<td>29</td>
<td>Aerobics</td>
<td>Yes</td>
<td>Yes</td>
<td>SUD</td>
<td>Syncope minutes before</td>
<td>None</td>
<td>78</td>
<td>460</td>
</tr>
<tr>
<td>30</td>
<td>Running</td>
<td>No</td>
<td>No</td>
<td>Pos-HCM</td>
<td>None</td>
<td>Exercise-related syncope diagnosed with athletes heart</td>
<td>106</td>
<td>680</td>
</tr>
<tr>
<td>30</td>
<td>Handball</td>
<td>Yes</td>
<td>Yes</td>
<td>SUD</td>
<td>None</td>
<td>Presyncope 1 week before during training</td>
<td>104</td>
<td>530</td>
</tr>
<tr>
<td>31</td>
<td>Boxing</td>
<td>Yes</td>
<td>Yes</td>
<td>CAD</td>
<td>None</td>
<td>None</td>
<td>92</td>
<td>510</td>
</tr>
<tr>
<td>32</td>
<td>Running</td>
<td>Yes</td>
<td>Yes</td>
<td>CAD</td>
<td>None</td>
<td>Exercise-related syncope</td>
<td>70</td>
<td>400</td>
</tr>
<tr>
<td>33</td>
<td>Handball</td>
<td>Yes</td>
<td>Yes</td>
<td>ARVC</td>
<td>Dizziness</td>
<td>2 admissions because of chest pain in preceding year</td>
<td>86</td>
<td>615</td>
</tr>
<tr>
<td>35</td>
<td>Soccer</td>
<td>No</td>
<td>No</td>
<td>Myocarditis</td>
<td>Dizziness</td>
<td>None</td>
<td>83</td>
<td>359</td>
</tr>
</tbody>
</table>

All decedents were male. Prodromal symptoms was defined as symptoms in the minutes leading up to the death, and antecedent symptoms was defined as symptoms in the year to months leading up to the death.

ARVC = arrhythmogenic right ventricular cardiomyopathy; CAD = coronary artery disease; CCAA = congenital coronary artery anomaly; LV = left ventricular; N/A = not available; Pos-HCM = possible hypertrophic cardiomyopathy; SUD = sudden unexplained death.
According to the National Danish Health and Morbidity Study in 2005, 10.9% of the Danish population in the age group 16 to 35 years old reported participating in competition-level sports.

The estimated size of the athlete population (n=177 070)
In Denmark sports related sudden cardiac death in the young is rare (1.2:100,000 person years)

(As comparison: 953 cases of accidental death vs 15 cases of SrSCD)
Veneto/Italian data
US/minnesota data

Athlete Deaths/100,000 Person-Y

Years

Veneto

Minnesota

p=0.006

p=0.88

Maron AJC 09
The incidence of SrSCD was 2.3: 100.000

Gender: Men
- 34 cardiac deaths in male athletes, incidence of SCD of 1:33 134 per year.
- 11 cardiac deaths in female athletes, incidence of SCD of 1:76 646 per year

Ethnicity: Black
- 27 deaths in whites, SCD rate of 1:58 653 athletes per year.
- 17 deaths in black athletes, incidence of SCD 1:17 696 per year.
Comparison of the Frequency of Sudden Cardiovascular Deaths in Young Competitive Athletes Versus Nonathletes: Should We Really Screen Only Athletes?

Barry J. Maron, MD\textsuperscript{a,*}, Tammy S. Haas, RN\textsuperscript{a}, Emily R. Duncanson, MD\textsuperscript{b}, Ross F. Garberich, MS\textsuperscript{a}, Andrew M. Baker, MD\textsuperscript{c}, and Shannon Mackey-Bojack, MD\textsuperscript{b}

The issue of sudden death in young athletes and consideration for the most practical and optimal strate
these tragic events. mandatory that these have confined to engage in competitive level. Therefore, larger populations are excluded from death. forensic Henn was 8-fold more common frequent in the athletes were hypertrophic cardiomyopathy (nonspecific screening for athletes).
12-49 y, 2007-9

8085 deaths in total

469 foreigners or Danes dying outside Danish borders

7616 deaths included

6548 non-sudden death

26 (0.3%) incomplete death certificate data

1043 (14%) sudden unexpected death

26 sudden unexpected death (competing causes)

453 non-autopsied sudden unexpected death

564 autopsied sudden unexpected death

136 sudden non-cardiac death

428 autopsied sudden cardiac death

881 (12%) sudden cardiac death
- 297 explained (after autopsy)
- 131 unexplained (after autopsy)
- 453 no autopsy performed

837 non-sports related SCD

44 sport related sudden cardiac death (SrSCD)
- 33 non-competitive athletes
- 11 competitive athletes
SrSCD death according to age

![Graph showing the number of SrSCD cases by age group for non-competitive and competitive athletes.](image)
## The numbers

### General pop:  
- **Competitive:**
  - Incidence rates per 100,000 person-years (dementia): 2.86–13.1
  - Non-competitive: 2.95 (1.95–4.30)

### Non-competitive:
- **Competitive:**
  - Incidence rates per 100,000 person-years (dementia): 2.86–13.1

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**Table 1: Sports-related sudden cardiac death by different age groups in Denmark from 2007–2009**

<table>
<thead>
<tr>
<th>SrSCD cases (n)</th>
<th>Age group population (in thousands)</th>
<th>Active competitive athletes</th>
<th>Active noncompetitive athletes</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>3</td>
<td>13.2%</td>
<td>28.7%</td>
</tr>
<tr>
<td>35</td>
<td>8</td>
<td>3.6%</td>
<td>27.3%</td>
</tr>
</tbody>
</table>

Incidence rates per 100,000 person-years (dementia): 2.67–3.69

**Competitive athletes (competitive athletes):** 3.15 (2.67–3.69)

**Noncompetitive athletes (noncompetitive athletes):** 0.43 (0.16–0.94)
Background—Sports-associated sudden cardiac arrest (SCA) incidence is underreported and poorly understood. The burden, characteristics, and outcomes of SCA in Oregon (Oregon-SUDS) were determined over a 12-year period.

Methods and Results—Patients with SCA were identified in a large-scale, population-based study (2002–2013), with systemwide SCA cases. Among 1247 subjects, 63 (5%) occurred during sports activities, with a confidence interval of 8.1–35.4 cases per million men (relative risk, 18.68; 95% confidence interval, 2.58–95% confidence interval, 53%; P<0.001) versus 51%; P<0.0001). Survival to hospital discharge was 41% (P=0.04). Sports SCA cases presented with chest pain in 56%, and overall, 36% of cases had a previous history of cardiovascular disease.

Conclusions—Sports-associated SCA is underrecognized and underreported. The high-risk population should be targeted for preventive and treatment strategies, reinforcing the idea of the high-benefit, low-risk approach. Our findings emphasize that targeted prevention strategies are needed for older athletes.

(Circulation. 2015;131:1)

Figure 2. Distribution of cardiovascular abnormalities associated with sudden cardiac arrest (SCA) in the 1247 subjects according to sports SCA (top, n=63) and nonsports SCA (bottom; n=1184).
Is screening the best public health approach to lower mortality in the young?

The results are hard to ignore. The suicide rates among those 15 to 24 in the United States and Denmark were not too far apart in the 1980s. Beginning in the end of that decade, however, Denmark’s began to decline faster than ours. In recent years, its suicide rate among young adults has been about half ours.

Some countries, like Italy and Israel, set up national screening programs to look for children at risk.
Conclusion

In the last years the incidence rate of sports related sudden cardiac death reported is somewhat equally low in US and Europe.

The low incidence rates in unscreened populations (Denmark and Israel) may reflect the true magnitude of SrSCD.

Money spend on lowering mortality of traffic accidents, OD and suicides seems to be a better approach to prevent death in the young.
The Danish approach:

- Not to screen
- (but we need more data)
- Investigate athletes with symptoms
- AED in sports facilities
Thank you!
ESC, but not Danish Society of Cardiology, recommend preparticipating screening

Proponets:
• Screening saves many lives (an observational study in Veneto)
• Low numbers of false positive

Opponents:
1. No proven effect of preparticipation screening.
2. the high number of disqualifications (false positives)
3. the impact on quality of life that a disqualification can have for the athlete,
4. the loss of beneficial effects of sport on health
5. the economic costs
6. False negative (3 last SrSCD in Europe)
7. A study calculated that 38,151 athletes must be screened to prolong 1 life, and in the process 791 athletes would be disqualified for each life prolonged.1

Definition of SCD

- The sudden, natural and unexpected death of unknown or cardiac cause;
  - in unwitnessed cases as a person last seen alive and functioning normally less than 24 hours before being found and
  - in witnessed cases as an acute change in cardiovascular status with time to death being less than 1 hour
Dansk Cardiologisk Selskab

Screening af unge idrætsudøvere i Danmark
Opdatering og vurdering, 2010
Drug overdoses have become the leading cause of death for Americans under 50.
## Comparison of data from Denmark, Veneto (Italy), Minnesota (US), and the entire United States

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Veneto&lt;sup&gt;1,12&lt;/sup&gt;</th>
<th>Minnesota&lt;sup&gt;10&lt;/sup&gt;</th>
<th>Entire United States&lt;sup&gt;9&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group</td>
<td>12–35</td>
<td>12–35</td>
<td>12–31</td>
<td>8–39</td>
</tr>
<tr>
<td>Total population, in thousands*</td>
<td>5,427</td>
<td>4,530</td>
<td>4,919</td>
<td>291,652</td>
</tr>
<tr>
<td>Age group population, in thousands*</td>
<td>1,624</td>
<td>1,385</td>
<td>1,383</td>
<td>131,313</td>
</tr>
<tr>
<td>Athletes in age group, %†</td>
<td>10.9%</td>
<td>8.1%</td>
<td>5.9%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Incidence rate per 100,000 person-years (denominator)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCD, general population (general population)</td>
<td>3.76</td>
<td>0.79</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>SCD, athletes (athletes)</td>
<td>1.21†</td>
<td>0.87</td>
<td>0.93</td>
<td>0.61</td>
</tr>
<tr>
<td>SCD, athletes (general population)</td>
<td>0.13†</td>
<td>0.079</td>
<td>0.072</td>
<td>0.050</td>
</tr>
<tr>
<td>Gender distribution, % women athletes</td>
<td>27%</td>
<td>20%&lt;sup&gt;12&lt;/sup&gt;</td>
<td>40%&lt;sup&gt;19&lt;/sup&gt;</td>
<td>N/A</td>
</tr>
<tr>
<td>Mean age of cases, yrs</td>
<td>26</td>
<td>23</td>
<td>17</td>
<td>18</td>
</tr>
</tbody>
</table>

N/A = not available.

†Based on the number of athlete person-years retrieved from the references listed.
‡Sports-related sudden cardiac death.
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