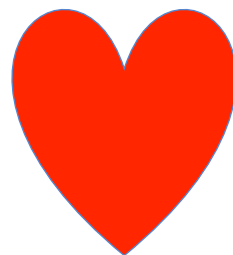


# Hjärtsscreening av idrottare



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# Causes of SCD in the young

Hypertrophic cardiomyopathy (HCM)

Other cardiomyopathies (ARVC)

Myocarditis, 3-7%

Coronary artery anomaly-CAA, 5-20%

Primary electrical disease (LQT, SQT, Brugada, WPW, PCVT)- 50% of "normal hearts"?

Other structural heart conditions, 3-8%

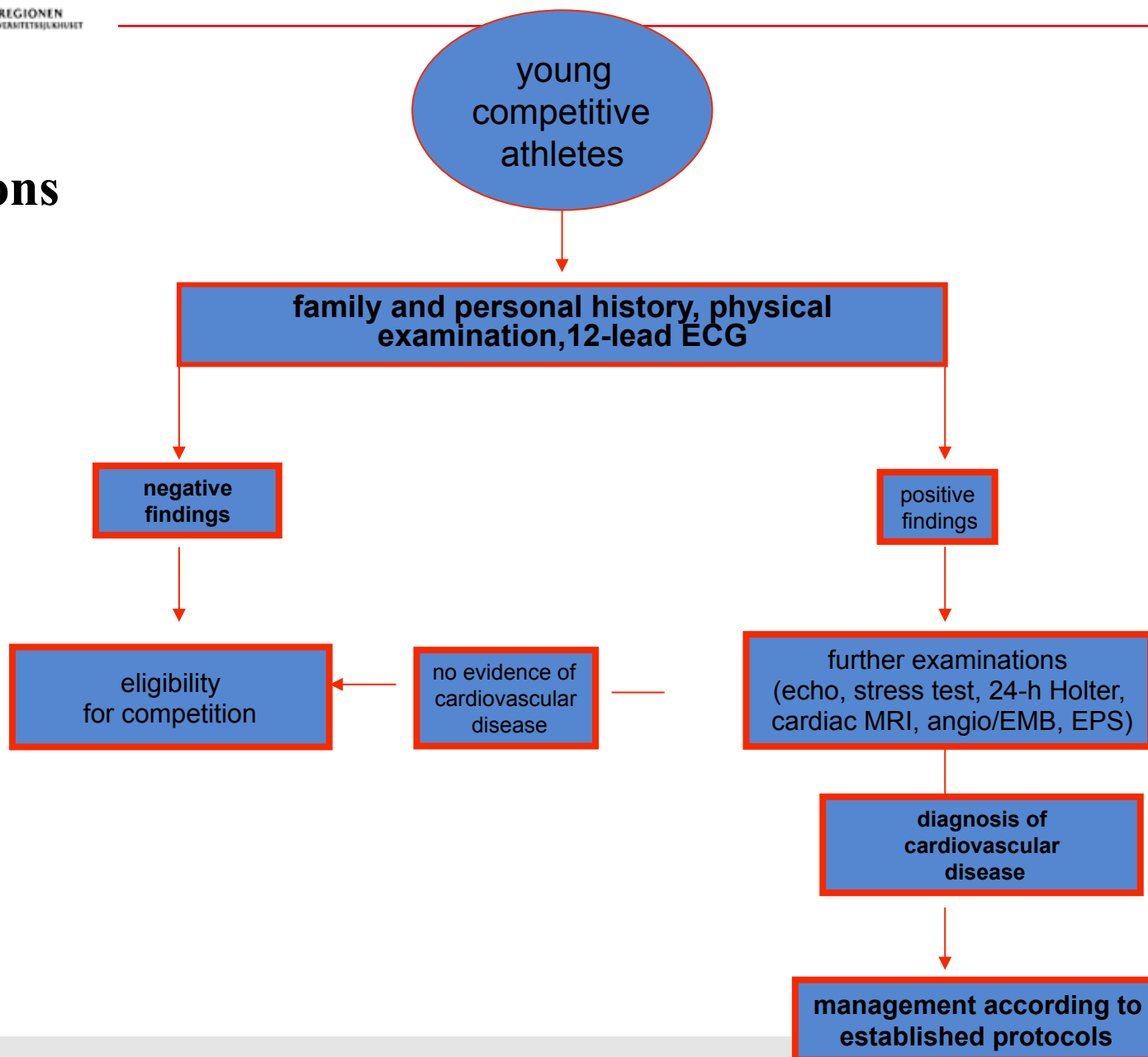
-aortic dissection

-valve disease (AS, MVP?)

Doping-?

CAA (left from right,  
Course between PA and  
aorta)

# ESC screening recommendations



Corrado et al,  
Eur Heart J 2005

# Sports Cardiology- ECG recommendations, April 2017

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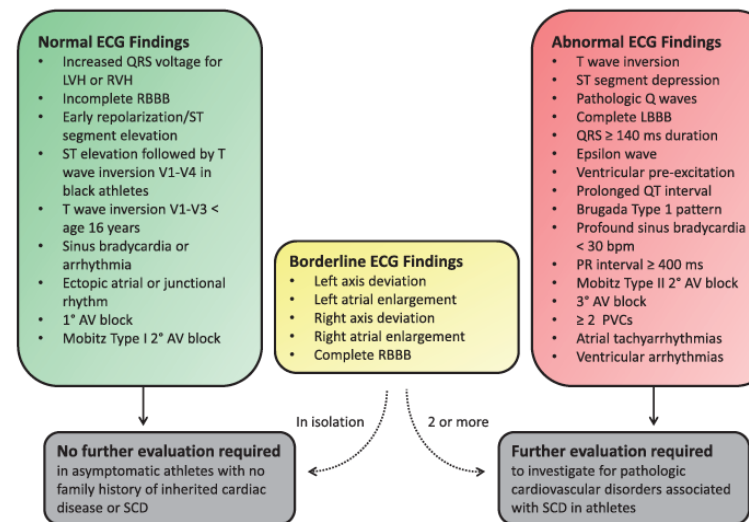
ISSN 0735-1097/\$36.00

<http://dx.doi.org/10.1016/j.jacc.2017.01.015>

## CURRENT OPINION

# International Recommendations for Electrocardiographic Interpretation in Athletes

Anjay Sharma, MD,<sup>a,\*</sup> Jonathan A. Drezner, MD,<sup>b,\*</sup> Aaron Baggish, MD,<sup>c</sup> Michael Papadakis, MD,<sup>a</sup>  
 Matthew G. Wilson, PhD,<sup>d</sup> Jordan M. Prutkin, MD, MHS,<sup>e</sup> Andre La Gerche, MD, PhD,<sup>f</sup> Michael J. Ackerman, MD, PhD,<sup>g</sup>  
 Mats Borjesson, MD, PhD,<sup>h</sup> Jack C. Salerno, MD,<sup>i</sup> Irfan M. Asif, MD,<sup>j</sup> David S. Owens, MD, MS,<sup>e</sup>  
 Eugene H. Chung, MD, MS,<sup>k</sup> Michael S. Emery, MD,<sup>l</sup> Victor F. Froelicher, MD,<sup>m</sup> Hein Heidbuchel, MD, PhD,<sup>n,o</sup>  
 Armen Adamuz, MD, PhD,<sup>d</sup> Chad A. Asplund, MD,<sup>p</sup> Gordon Cohen, MD,<sup>q</sup> Kimberly G. Harmon, MD,<sup>b</sup>  
 Joseph C. Marek, MD,<sup>r</sup> Silvana Molossi, MD,<sup>s</sup> Josef Niebauer, MD, PhD,<sup>t</sup> Hank F. Pelto, MD,<sup>b</sup> Marco V. Perez, MD,<sup>u</sup>  
 Nathan R. Riding, PhD,<sup>d</sup> Tess Saarel, MD,<sup>v</sup> Christian M. Schmied, MD,<sup>w</sup> David M. Shipon, MD,<sup>x</sup>  
 Ricardo Stein, MD, ScD,<sup>y</sup> Victoria L. Vetter, MD, MPH,<sup>z</sup> Antonio Pelliccia, MD,<sup>aa</sup> Domenico Corrado, MD, PhD<sup>bb</sup>



# Meta-analysis: sensitivity



EVIER

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)
**ScienceDirect**

Journal of Electrocardiology 48 (2015) 329–338

JOURNAL OF  
Electrocardiology[www.jecgonline.com](http://www.jecgonline.com)

## Effectiveness of screening history, physical exam, and ECG to detect potentially lethal cardiac disorders in athletes: A systematic review/meta-analysis

 Kimberly G. Harmon, M.D.,<sup>a,b,\*</sup> Monica Zigman, M.P.H.,<sup>a</sup> Jonathan A. Drezner, M.D.<sup>a</sup>
<sup>a</sup> Department of Family Medicine, University of Washington, Seattle, WA, USA<sup>b</sup> Department of Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA

analysis of pooled data.

	ECG	History	Physical
ty	94% (79%–98%)	20% (7%–44%)	9% (3%–
ty	93% (90%–96%)	94% (89%–96%)	97% (95%–
likelihood ratio*	14.8 (9.43–23.16)	3.22 (1.3–8.01)	2.93 (1.26–
e likelihood ratio*	0.055 (0.012–0.25)	0.85 (0.68–1.07)	0.93 (0.85–

etation of likelihood ratios

IEW!

# Exercise related sudden cardiac death (SCD) in the young

- pre-mortal characterization of a Swedish nationwide cohort, showing a decline in SCD among athletes

Presented at ESC Congress, Paris, Sep 2, 2019

Accepted for publication  
Resuscitation, Sep 19,

Aase Wisten	Umea University, Umea, Sweden
Mats Börjesson	Sahlgrenska Academy - University of Gothenburg, Goteborg, Sweden
Peter Krantz	Lund University, Lund, Sweden
Eva-Lena Stattin	Uppsala University, Uppsala, Sweden



# Exercise related SCD in 10-35-year olds in Sweden

- 514 cases of SCD, 373 men (73%) and 141 (27%) women 2000-2010\*
  - 62 cases of exertional SCD, 56 men (90%) and 6 women (10%)
    - 21/62 (33%) were athletes\*\*
- 30/62 (48%) had premortal risk factors
  - Cardiac symptoms/diagnoses (n= 25)
  - Family history (n=9)
  - ECG abnormalities\*\*\* (n=18)

Wisten et al. **Sudden cardiac death among the young in Sweden from 2000 to 2010: an autopsy-based study.** Europace. 2017 Aug 1;19(8):1327-1334. doi: 10.1093/europace/euw249.

defined as a person who participated in an organized team or individual sport that required regular practice and competitions.

Sharma et al. **International recommendations for electrocardiographic interpretation in athletes.** [Eur Heart J.](#) 2018 Apr 21;39(16):1466-1480. doi: 10.1093/eurheartj/ehw631



# Athletes vs non-athletes

- SCD during exercise was more common in athletes (21/29) than in non-athletes (41/485) ( $P < 0.0001$ )
- Decline in SCD
  - 5 SCD/year in athletes 15-35 years old (1992-1999)\*
  - 2.3 SCD/year in athletes 15-35 years old (2000-2010)

\*Wisten et al. Sudden cardiac death in 15-35-year olds in Sweden during 1992-99. JIM. 2002;252(6):529-36

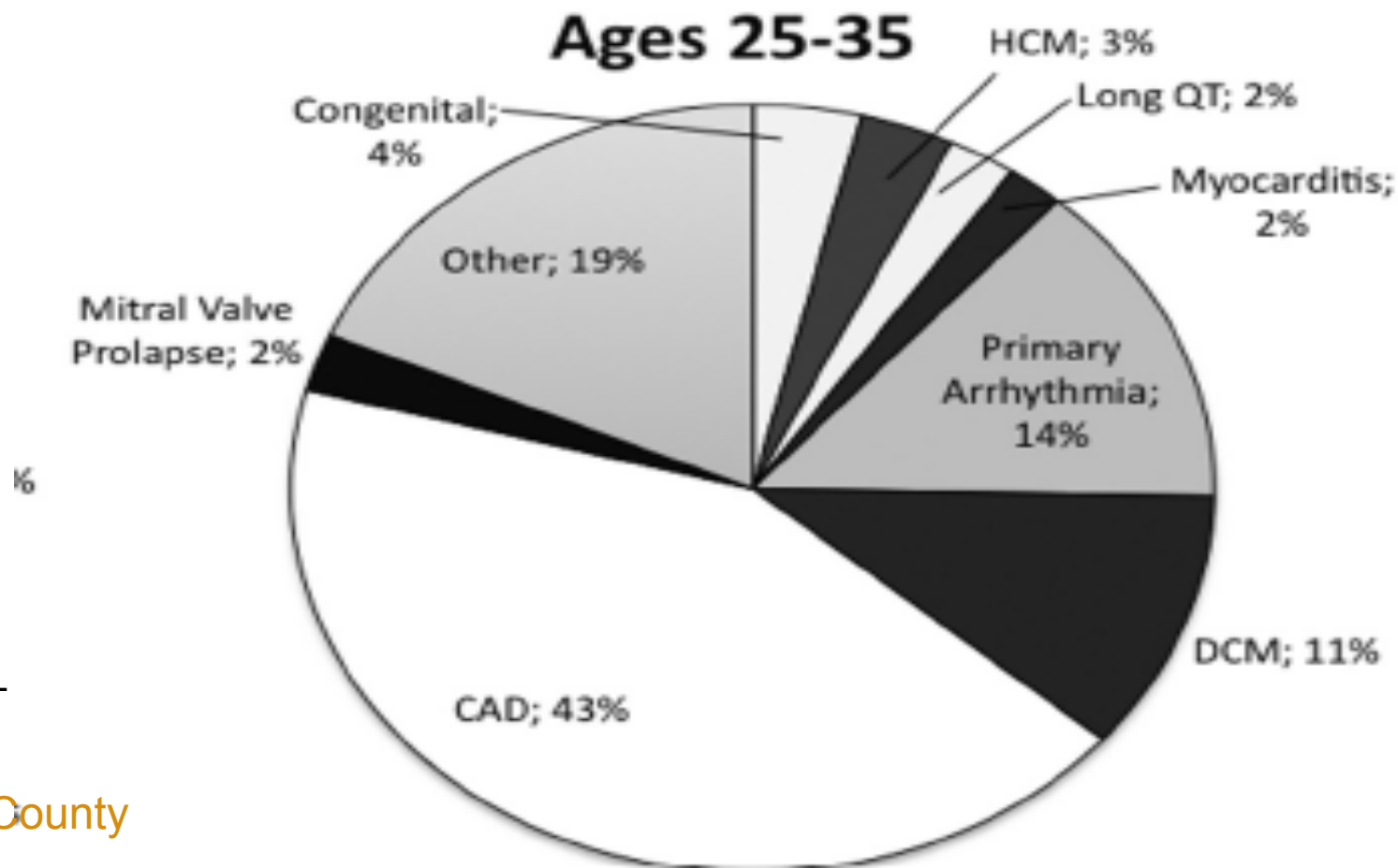


# Study conclusion

- 12% of SCD in the young was exercise-related
- The risk of exercise-related SCD was higher for athletes
- Exercise seemed to trigger SCD in men with HCM and ARVC
- About 50% had a premortal risk profile
- *SCD incidence in athletes in the 2000's has been halved compared to the 1990's*

# D most common cause of SCD from 25-35y

Master athletes↑



Myers L

Kings County

Incidence: 4.40/100 000  
Person years



# Subclinical disease among veterans...

*Sahlen, 2009)*

- N=185 from 30 km cross-country race
- 71% male; mean age 62y; no known cardiac disease
- NT-pro BNP and hs-CRP measured
- Results: 15 NT-proBNP >194 ng/L

⇒ 4 of those severe CVD

1 Male 57; BNP 219; CRP 0.2; BP 176/108+ ascending aortic aneurysm

2 Male 74; BNP 2250; CRP 2.6; LVH, EF 30%, atrial fibrillation

3 Male 65; BNP 339; CRP 2.4: **severe CAD** leading to CABG

4 Male 69; BNP 363; CRP 2.0; SCD, **severe CAD**, silent MI, LVH

# Screening of the older athlete

Review

European Journal of  
**Cardiovascular  
Prevention &  
Rehabilitation**



European Journal of Cardiovascular  
Prevention & Rehabilitation

18(3) 446–458

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Cardiology 2011

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DOI: 10.1177/HJR.0b013e32833bo

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## Cardiovascular evaluation of middle-aged/ senior individuals engaged in leisure-time sport activities: position stand from the sections of exercise physiology and sports cardiology of the European Association of Cardiovascular Prevention and Rehabilitation

Mats Borjesson<sup>1</sup>, Alex Urhausen<sup>2</sup>, Evangelia Kouidi<sup>3</sup>,  
Dorian Dugmore<sup>4</sup>, Sanjay Sharma<sup>5</sup>, Martin Halle<sup>6</sup>,  
Hein Heidbüchel<sup>7</sup>, Hans Halvor Björnstad<sup>8</sup>, Stephan Gielen<sup>9</sup>,  
Alessandro Mezzani<sup>10</sup>, Domenico Corrado<sup>11</sup>,  
Antonio Pelliccia<sup>12</sup> and Luc Vanhees<sup>13</sup>

Screening recommendations according to:

1. Intensity-level of intended PA;
2. Risk profile;
3. Habitual exercise



# Initial self-assessment

- Initially, by a **self-evaluation**
  - AHA/ACSM questionnaire
  - revised PAR-Q
- Secondarily, a risk stratification by a physician (if necessary)
  - by SCORE

**Table 2.** Revised Physical Activity Readiness Questionnaire

1	Has a doctor ever said that you have a heart condition and recommended only medically supervised activity?	Yes/N
2	Do you have chest pain brought on by physical activity?	Yes/N
3	Have you developed chest pain in the past month?	Yes/N
4	Have you on 1 or more occasions lost consciousness or fallen over as a result of dizziness?	Yes/N
5	Do you have a bone or joint problem that could be aggravated by the proposed physical activity?	Yes/N
6	Has a doctor ever recommended medication for your blood pressure or a heart condition?	Yes/N
7	Are you aware, through your own experience or a doctor's advice, of any other physical reason that would prohibit you from exercising without medical supervision?	Yes/N

Adopted from Balady. *Circulation* 1998; 97:2283-2293.

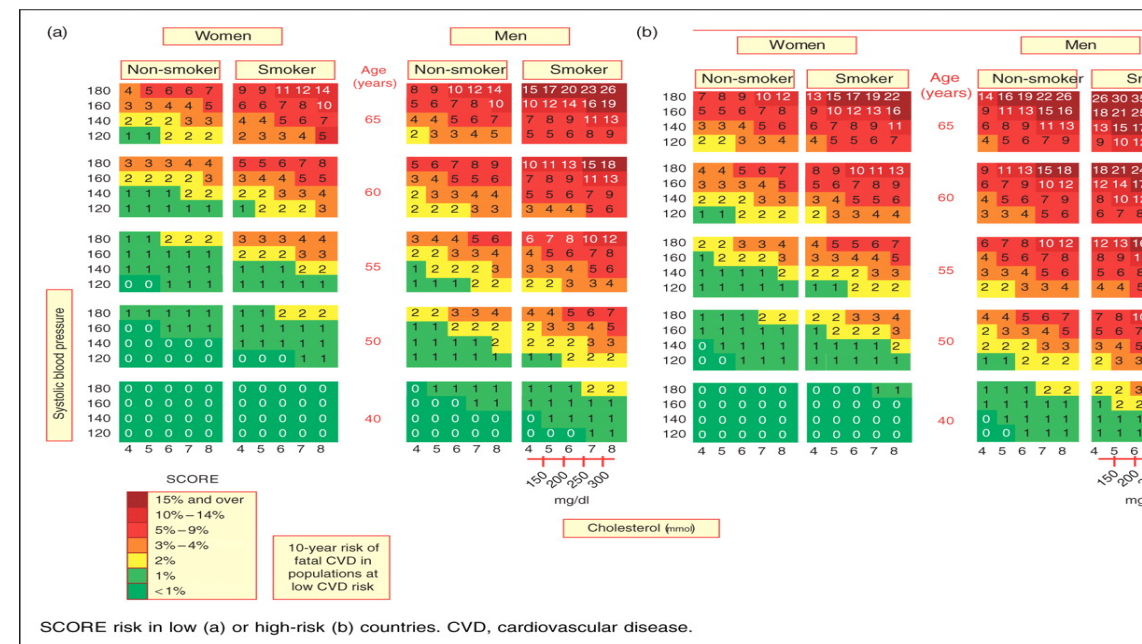
# Risk factor profile

In asymptomatic subjects, the total CAD-risk level can be estimated from the presence of major risk factors, according to the SCORE (systematic coronary risk evaluation)-system

- blood pressure
- age
- sex
- smoking
- total cholesterol (ESC prevention)

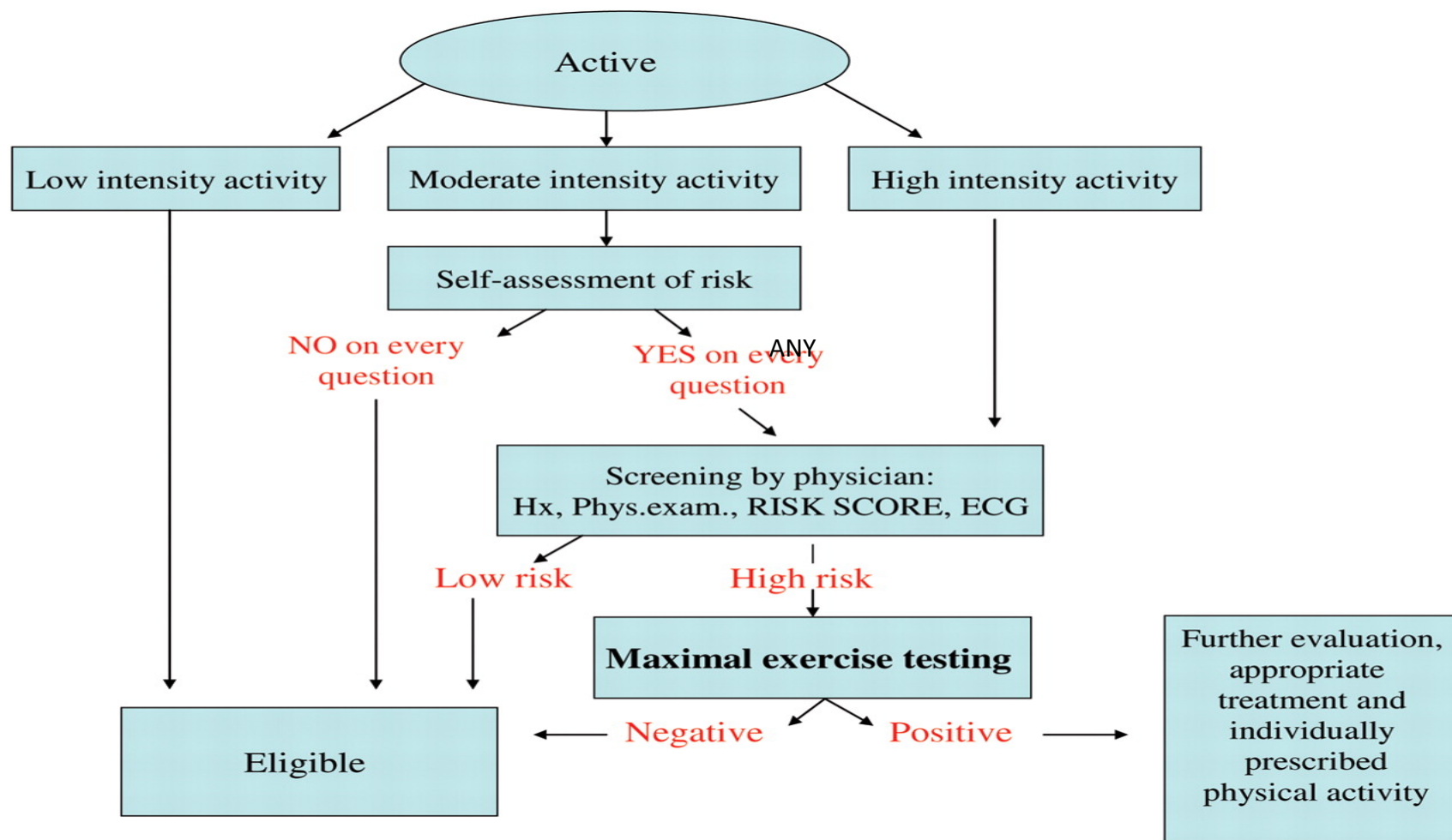
In addition, **diabetes** and **family history** can be added

os! Framingham risk score (FRS) similar





## Specific pre-participation screening work-up for regularly active middle-aged/senior individuals.



# Pre-Race SAFER Intervention Study

## Pre intervention (2008-2011) - Post intervention (2012 – 2015)

*Does a pre-race screening and educational intervention reduce medical complications during a race?*

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2018-099275>).

For numbered affiliations see end of article.

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Accepted 26 October 2018



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Prerace medical screening and education reduced medical encounters in distance road races: SAFER study in 153 208 race starters

Martin Schwellnus,<sup>1,2,3</sup> Sonja Swanevelde,<sup>4</sup> Wayne Derman,<sup>2,5</sup> Mats Borjesson,<sup>6</sup> Karen Schwabe,<sup>9</sup> Esme Jordaan<sup>4,10</sup>

### ABSTRACT

**Objectives** To examine the efficacy and feasibility of an online prerace medical screening and educational intervention programme for reducing medical complications in long-distance races.

**Methods** This was an 8-year observational study of medical encounter rates among 153 208 Two Oceans race starters (21.1 and 56 km) in South Africa. After the first 4-year control (CON) period, we introduced an online prerace medical screening (based on European pre-exercise screening guidelines) and an automated educational intervention programme. We compared the incidence of medical encounters (per 1000 starters; all and serious life threatening) in the CON versus the 4-year intervention (INT) period.

**Results** In comparison to the CON period (2008–2011: 65 865 starters), the INT period (2012–2015: 87 343 starters) had a significantly lower incidence (adjusted for age group, sex, race distance) of all medical encounters by 29% (CON=8.6 (7.9–9.4); INT=6.1 (5.6–6.7),  $p<0.0001$ ), in the 21.1 km race by 19% (CON=5.1 (4.4–5.9); INT=4.1 (3.6–4.8),  $p=0.0356$ ) and in the 56 km race by 39% (CON=14.6 (13.1–16.3); INT=9.0 (7.9–10.1),  $p<0.0001$ ). Serious life-threatening encounters were significantly reduced by 64% (CON=0.6 (0.5–0.9); INT=0.2 (0.1–0.4);  $p=0.0003$ ) (adjusted for age group and sex). Registration numbers increased in the INT period (CON=81 345; INT=106 743) and overall % race starters were similar in the CON versus INT period. Wet-bulb globe temperature was similar in the CON and INT periods.

**Conclusion** All medical encounters and serious life-threatening encounters were significantly lower after the introduction of a prescreening and educational intervention programme, and the programme was feasible.

### INTRODUCTION

Regular physical activity (PA) is an important lifestyle intervention for primary and secondary prevention of non-communicable disease.<sup>1–3</sup> The recommended minimum weekly healthy 'dose' of exercise is 150 min at moderate to vigorous intensity.<sup>4–7</sup> Mass community-based sports events such as distance running events have, over the last two to three decades, seen substantial growth in participant numbers,<sup>8</sup> with a notable increase in older participants (<http://www.runningusa.org/annual-reports>). While regular PA has numerous health benefits, PA is associated with medical encounters,<sup>9 10</sup> including acute myocardial infarction and sudden death.<sup>11–16</sup>

### What are the findings?

- An online prerace medical screening and educational intervention programme significantly reduce medical encounters and alter race starter risk profile.
- It is feasible to implement an online prerace medical screening and educational programme at a mass community-based running event.
- The results of this study have the potential to change current practice of providing care at mass community-based sports events worldwide.
- Race organisers and race medical teams should consider implementing such programmes to improve race safety.

### How might it impact on clinical practice in the future?

- Race medical directors and race organisers may consider implementing an online prerace medical screening and educational programme at mass community-based endurance events.
- Race medical directors and race organisers should document the impact of implemented programmes.
- Implementation of prerace medical screening and education could lead to improved race safety.
- The results of this study have the potential to change policy.

The reported absolute risk of sudden cardiac death during marathons, and similar races, varies between 0.003 and 0.033 per 1000 race entrants, but is higher in older entrants, and during evening medical encounters during well studied events,<sup>17–23</sup> but is about 0.003 per entrants (0.17–1.55 per 1000 race starters). To reduce the risk of acute medical encounters during sport, precompetition medical screening has been proposed, with the main aim to identify elite athletes.<sup>24–29–33</sup> However, the population has a higher incidence of medical complications during exercise,<sup>34</sup> and international organisations have



# Design and implementation

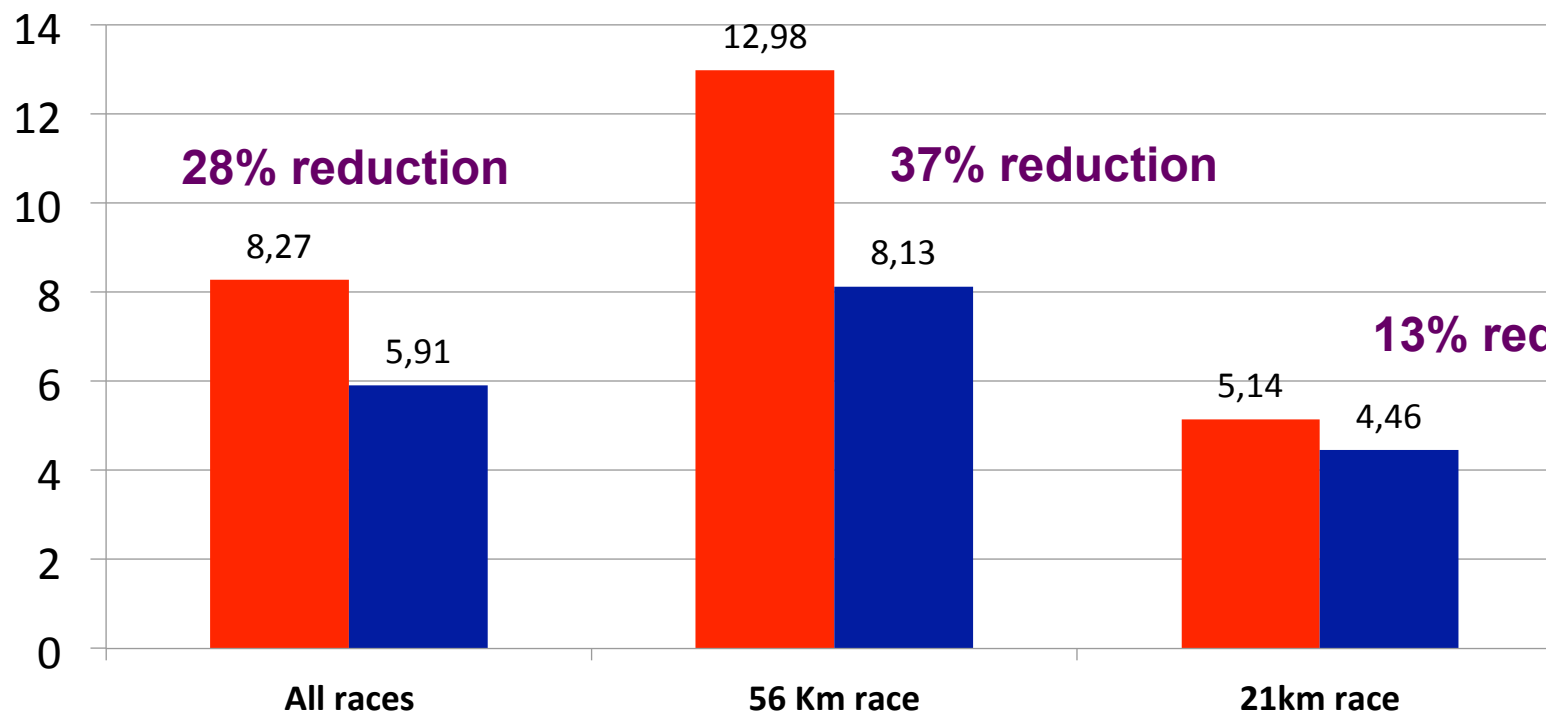
## Three-step SAFER screening and educational intervention program:

1. Compulsory completion of a pre-participation medical questionnaire at race entry (4-6 months before an event)
2. Risk stratification:
  - **Very high risk** – Existing CVD, symptoms of CVD
  - **High risk** – Risk factors for CVD
  - **Intermediate risk** – Other chronic disease, medication use, history of medical complications during exercise
  - **Low risk** – “No” answer to all medical screening questions
3. Educational intervention:
  - Personalized educational information
  - General medical educational

# Pre- vs. Post Screening (2008-2015)(Incidence of all medical complications)

■ Pre intervention (2008-2011) ■ Post intervention (2012-2015)

Incidence per 1000 runners



Schwellnus M, Schwabe K, Swanevelder S, Jordaan E, Derman W, et al, BJSM, April 2019

**Additional material** is published online only, to view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2018-095775).  
For numbered citations see end of article.  
**Correspondence** to: Dr Martin Schwellnus, Department of Exercise Science and Health, Stellenbosch University, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa; mschwell@sun.ac.za  
Accepted 20 October 2018

**OBJECTIVES** To examine the efficacy and feasibility of an online pre-event medical screening and educational intervention programme for reducing medical complications in long-distance races.  
**Methods** This was an 8-year observational study of medical encounter rates among 153 208 two Oloren race starters (21.1 and 56 km) in South Africa. After the first 4-year control (CON) period, we introduced an online pre-event medical screening (based on European pre-event screening guidelines), and an automated educational intervention programme. We compared the incidence of medical encounters (per 1000 starters; all and serious life-threatening) in the CON versus the 4-year intervention (INT) period.  
**Results** In comparison to the CON period (2008–2011), 65 865 starters, the INT period (2012–2015; 87 343 starters) had a significantly lower incidence (adjusted for age group, sex, race distance) of all medical encounters by 29% (CON=8.6 (7.9–9.4); INT=6.1 (5.6–6.7),  $p<0.0001$ ), in the 21.1 km race by 19% (CON=5.1 (4.4–5.9); INT=4.1 (3.6–4.6),  $p=0.0050$ ) and in the 56 km race by 39% (CON=14.4 (13.1–16.1); INT=8.9 (7.9–10.1),  $p<0.0001$ ). Serious life-threatening encounters were significantly reduced by 64% (CON=0.6 (0.3–0.9); INT=0.2 (0.1–0.4),  $p=0.0003$ ) (adjusted for age group and sex). Registration numbers increased in the INT period (CON=81 345; INT=106 743) and overall % race starters were similar in the CON versus INT period. Web-bulk globe temperature was similar in the CON and INT periods.  
**Conclusion** All medical encounters and serious life-threatening encounters were significantly lower after the introduction of a pre-screening and educational intervention programme, and the programme was feasible.

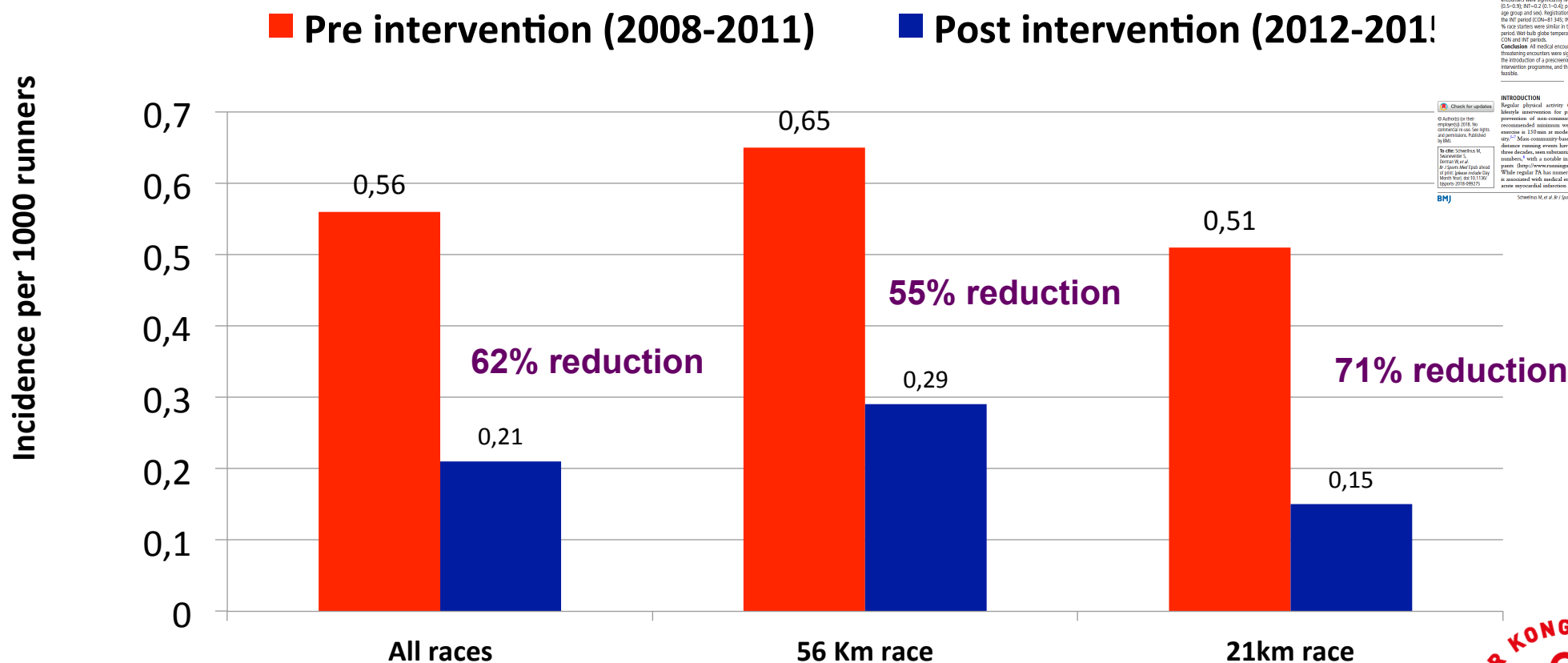
**INTRODUCTION** Regular physical activity (PA) is an important lifestyle intervention for primary and secondary prevention of non-communicable diseases.<sup>1–3</sup> The recommended minimum weekly healthy 'dose' of exercise is 150 min at moderate to vigorous intensity.<sup>4</sup> Most contemporary based sports events such as distance running events have, over the last two to three decades, seen substantial growth in participant numbers,<sup>5</sup> with a notable increase in older participants.<sup>6</sup> Long-term consequences of over-exercising (overtraining syndrome) have been reported in the general population.<sup>7</sup> While regular PA has numerous health benefits, PA is associated with medical encounters,<sup>8</sup> including acute myocardial infarction and sudden death.<sup>9,10</sup>

Schwellnus M, et al. *Br J Sports Med* 2019;0:1–7. doi:10.1136/bjsports-2018-095775

BMJ



# Pre- vs. Post Screening (2008-2015) (Incidence of serious life threatening medical complications)

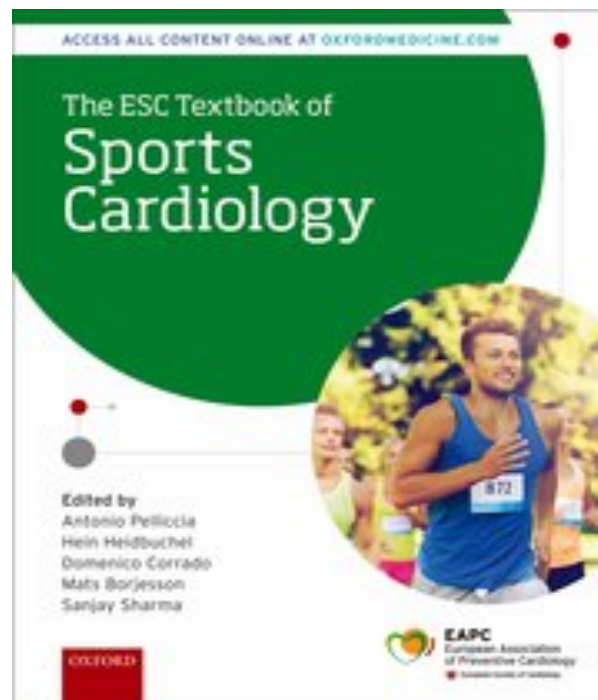


Schwellnus M, Schwabe K, Swanevelder S, Jordaan E, Derman W, et al, BJSM, Apr 2019

**Abstract**  
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**Methods** This was an 8-year observational study of medical encounter rates among 153 208 two Océans race starters (21.1 and 56.2 km) in South Africa. After the first 4-year control (CON) period, we introduced an online pre-race medical screening (based on European pre-race screening guidelines), and an automated educational intervention programme. We compared the incidence of medical encounters per 1000 starters; all and serious life-threatening (SLT) in the CON versus the 4-year intervention (INT) period.  
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# To read more...



2019

