Is there a role for preparticipation screening in middle-aged athletes?

Europrevent, Prague, 100507

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Regular physical activity is associated with a lower risk for cardiovascular disease and mortality. Therefore…Increased physical activity is a priority in cardiovascular prevention and rehabilitation.
However...also risks in sport

JOY!  SCD!

⇒

Antonio Puerta
*01.05.1975 - 28.8.2007
FC Sevilla - FC Getafe
Competitive athletes have a higher risk than the population at large (if underlying abnormality).
Middle aged athletes

• "Master athletes": Defined as >35 years of age (40), may be significantly older
• Organized form of competitive sports, specifically designed for older athletes (over 50 sports: running, cycling, skiing..)

"..unique psychological and physiological stresses that competition places on such athletes, particularly those with cardio-vascular disease” : AHA 2001
Athletes and coronary artery disease

- SCD increases transiently during vigorous physical activity
- PA causes dilatation in normal coronaries, but may cause vasoconstriction in atherosclerotic segments (Gordon, J Clin Invest -89)
- Aggravating factors during exercise
  - catecholamine release
  - platelet adhesion/activation (Cadroy, J Appl Phys -02)
  - electrolyte disturbances (i.e. potassium)
  - heat/cold/altitude related complications (O’Donnell,NEJM -72)
  - doping/drugs (Heesch, Heart -00, Kennedy, Med J Aust -93)
TABLE 3. Physical Stress as a Trigger of Acute Cardiovascular Events During Vigorous Exertion*

<table>
<thead>
<tr>
<th>Study</th>
<th>Effect Period</th>
<th>End Point</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle study (^5) (1984)</td>
<td>&lt;1 h</td>
<td>Primary cardiac arrest</td>
<td>56 (23–131)(^\dagger)</td>
</tr>
<tr>
<td>Onset study (^32) (1993)</td>
<td>1 h</td>
<td>Nonfatal MI</td>
<td>5.9 (4.6–7.7)</td>
</tr>
<tr>
<td>TRIMM study (^31) (1993)</td>
<td>1 h</td>
<td>Nonfatal MI</td>
<td>2.1 (1.1–3.6)</td>
</tr>
<tr>
<td>Hartford Hospital AMI study (^6) (1999)</td>
<td>1 h</td>
<td>Nonfatal MI</td>
<td>10.1 (1.6–55.6)</td>
</tr>
<tr>
<td>SHEEP study (^40) (2000)</td>
<td>&lt;15 min</td>
<td>Nonfatal MI</td>
<td>6.1 (4.2–9.0)</td>
</tr>
<tr>
<td>Physician’s Health Study (^7) (2000)</td>
<td>30 min</td>
<td>SCD</td>
<td>16.9 (10.5–27)</td>
</tr>
</tbody>
</table>

RR indicates relative risk and compares the risk of the cardiac event during exertion with that during sedentary activities; TRIMM, Triggers and Mechanisms of Myocardial Infarction Study; and SHEEP, Stockholm Heart Epidemiology Programme.

\(^\ast\)Vigorous exertion is exercise intensity \(\geq 6\) METs (1 MET = 3.5 mL \cdot kg\(^{-1}\) \cdot min\(^{-1}\)).

\(^\dagger\)This RR (56) is the exertion RR for habitually sedentary men. The RR (vs no prior vigorous exercise) for the most active men (\(\geq 140\) min/wk vigorous exertion) was 5 (95% CI, 2 to 14).

Adapted from Mittleman,\(^{41}\) with permission from Blackwell Publishing.
Screening - one solution

ESC Report

Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death: proposal for a common European protocol

Consensus Statement of the Study Group of Sport Cardiology of the Working Group of Cardiac Rehabilitation and Exercise Physiology and the Working Group of Myocardial and Pericardial Diseases of the European Society of Cardiology

Domenico Corrado\textsuperscript{1*}, Antonio Pelliccia\textsuperscript{2}, Hans Halvor Bjørnstad\textsuperscript{3}, Luc Vanhees\textsuperscript{4}, Alessandro Biffi\textsuperscript{2}, Mats Borjesson\textsuperscript{5}, Nicole Panhuyzen-Goedkoop\textsuperscript{6}, Asterios Deligiannis\textsuperscript{7}, Erik Solberg\textsuperscript{8}, Dorian Dugmore\textsuperscript{9}, Klaus P. Mollwig\textsuperscript{10}, Deodato Assanelli\textsuperscript{11}, Pietro Delise\textsuperscript{12}, Frank van-Buuren\textsuperscript{10}, Aris Anastasakis\textsuperscript{13}, Hein Heldbuchel\textsuperscript{4}, Ellen Hoffmann\textsuperscript{14}, Robert Fagard\textsuperscript{4}, Silvia G. Priori\textsuperscript{15}, Cristina Basso\textsuperscript{19}, Eloisa Arbustini\textsuperscript{16}, Carina Blomstrom-Lundqvist\textsuperscript{17}, William J. McKenna\textsuperscript{18}, and Gaetano Thiene\textsuperscript{19}
Predisposing Factors and Consequences of Elevated Biomarker Levels in Long-Distance Runners Aged >55 Years
Anders Sahlén, MDa,*, Thomas P. Gustafsson, MSc, Lic Med Scb, Jan E. Svensson, MD, PhDb, Tony Marklund, BSc, Reidar Winter, MD, PhDal, Cecilia Linde, MD, PhDal, and Frieder Braunschweig, MD, PhDal

Cardiac biomarkers play an important role in the diagnosis of cardiovascular disease. Elevated levels can be seen in the context of strenuous exercise. We studied this phenomenon in senior endurance runners. We included 185 participants (61.1 ± 5 years; 29% women) at a 30-km cross-country race who were self-reportedly in excellent health. Before and after the race, the creatinine, N-terminal pro-brain natriuretic peptide (NT-proBNP), and troponin T were analyzed, and participation in the number of previous races and the race duration were recorded. NT-proBNP increased from 53 ng/L (interquartile range 31 to 89) to 121 ng/L (interquartile range 79 to 184) and troponin T from undetectable to 0.01 g/L (interquartile range 0.01 to 0.04). The independent predictors of a large NT-proBNP increase were (1) greater levels present at baseline, (2) a greater increase in creatinine (both p <0.001), (3) older age (p 0.01), and (4) a longer race duration (p <0.05). Troponin T elevation was independently predicted by (1) older age (p 0.01), (2) a greater increase in creatinine, and (3) participation in fewer previous races (both p <0.05). Of the 15 runners with an elevated (>194 ng/L) baseline NT-proBNP level (8.1% of 185), 4 were found to have serious cardiovascular disease (2.2% of whole sample). Of these 4 patients, 1 died from sudden cardiac death within months after the race. In conclusion, biomarker elevation occurs commonly in senior runners. A high baseline NT-proBNP is predictive of a large release during exercise, suggesting that the factors that control the at rest levels also determine its release with exertion. Troponin T elevation was seen in less-experienced participants. A small group of very ill runners were identified by NT-proBNP analysis. © 2009 Elsevier Inc. All rights reserved. (Am J Cardiol 2009;104:1434 –1440)
NT-proBNP and TnT before and after 30-km race
Biomarker release stratified by age
(Sahlen A, Am J Cardiol 2009;104:1434-40)
AHA recommendations for screening of masters athletes (Circulation 2001;103:327-34)

• ALL master athletes should undergo screening by personal and family history and physical ex
• Standard 12-lead ECG for all >40 (men and women)
• Those >40 (men), >50 (women) with 1 more risk factor (lipids, HT, smoker, diabetes, pos fam history CAD) should undergo maximal exercise-testing
• Exercise-test in ALL >65 and in those with symptoms of CAD
The goal is to achieve all the benefits of PA and avoid the negative effects at the same time.
EACPR recommendations

”Cardiovascular evaluation of adult/senior individuals engaged in leisure-time or competitive sport activities”

Position Stand from the Sections of Sports Cardiology and Exercise Physiology, within the European Association for Cardiovascular Prevention and Rehabilitation (EACPR)

Screening recommendations according to:

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

Risk for cardiovascular disease

Physical activity level/intensity

Inactive/low intensity | very intense | extremely intense

---
Intensity-level of intended activity

<table>
<thead>
<tr>
<th></th>
<th>A. Low dynamic</th>
<th>B. Moderate dynamic</th>
<th>C. High dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Low static</td>
<td>Bowling</td>
<td>Fencing</td>
<td>Badminton</td>
</tr>
<tr>
<td></td>
<td>Cricket</td>
<td>Table tennis</td>
<td>Race walking</td>
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<tr>
<td></td>
<td>Golf</td>
<td>Tennis (doubles)</td>
<td>Running (marathon)</td>
</tr>
<tr>
<td></td>
<td>Riflery</td>
<td>Volleyball</td>
<td>Cross-country skiing (classic)</td>
</tr>
<tr>
<td>II. Moderate static</td>
<td>Auto racing(^a,b)</td>
<td>Baseball(^a)/softball(^a)</td>
<td>Squash(^a)</td>
</tr>
<tr>
<td></td>
<td>Diving(^b)</td>
<td>Field events (jumping)</td>
<td>Basketball(^a)</td>
</tr>
<tr>
<td></td>
<td>Equestrian(^a,b)</td>
<td>Figure skating(^a)</td>
<td>Biathlon</td>
</tr>
<tr>
<td></td>
<td>Motorcycling(^a,b)</td>
<td>Lacrosse(^a)</td>
<td>Ice hockey(^a)</td>
</tr>
<tr>
<td></td>
<td>Gymnastics(^a)</td>
<td>Running (sprint)</td>
<td>Field hockey(^a)</td>
</tr>
<tr>
<td></td>
<td>Karate/Judo(^a)</td>
<td></td>
<td>Rugby(^a)</td>
</tr>
<tr>
<td></td>
<td>Sailing</td>
<td></td>
<td>Soccer(^a)</td>
</tr>
<tr>
<td></td>
<td>Archering</td>
<td></td>
<td>Cross-country skiing (skating)</td>
</tr>
<tr>
<td>III. High static</td>
<td>Bobsledding(^a,b)</td>
<td>Body building(^a)</td>
<td>Canoeing, Kayaking</td>
</tr>
<tr>
<td></td>
<td>Field events (throwing)</td>
<td>Downhill skiing(^a,b)</td>
<td>Decathlon</td>
</tr>
<tr>
<td></td>
<td>Luge(^a,b)</td>
<td>Wrestling(^a)</td>
<td>Rowing</td>
</tr>
<tr>
<td></td>
<td>Rock climbing(^a,b)</td>
<td>Snow boarding(^a,b)</td>
<td>Speed skating</td>
</tr>
<tr>
<td></td>
<td>Waterskiing(^a,b)</td>
<td></td>
<td>Triathlon(^a,b)</td>
</tr>
<tr>
<td></td>
<td>Weight lifting(^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Windsurfing(^a,b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted and modified after Mitchell et al.\(^5\)

\(^a\)Danger of bodily collision.

\(^b\)Increased risk if syncope occurs.
2. Individual risk profile

- In asymptomatic subjects, the total IHD-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

(Third Joint European Task Force for cardiovasc prevention)

- In addition, diabetes and family history are added
Individual risk profile

- Initially, by a self-evaluation
  - AHA/ACSM questionnaire
  - revised PAR-Q
- Secondarily, a risk stratification by a physician (if necessary)
  - SCORE
First line self-assessment: alternative 1

American Heart Association (AHA)/American College of Sport Medicine (ACSM)
Health/Fitness facility preparticipation screening questionnaire

(adopted from Balady, Circulation 1998;97:2283-93)

Section I

History
You have had:
___a heart attack
___heart surgery
___cardiac catheterization
___coronary angioplasty (PCI)
___pacemaker/implantable cardiac defibrillator/rhythm disturbance
___heart valve disease
___heart failure
___heart transplantation
___congenital heart disease

Symptoms
___you experience chest discomfort with exertion
___you experience unreasonable breathlessness
___you experience dizziness, fainting, blackouts
___you take heart medications

Other health issues
___you have musculoskeletal problems
___you have concerns about the safety of exercise
___you take prescription medication(s)
___you are pregnant

If you have marked any of the statements in section I, consult your healthcare provider before engaging in exercise. You may need to use a facility with a medically qualified staff.
Continued..

Section II

**Cardiovascular risk factors**

___you are a man older than 45 years
___you are a woman older than 55 years or you have had a hysterectomy or you are postmenopausal
___you smoke
___your blood pressure is >140/90
___you don't know your blood pressure
___you take blood pressure medication
___your cholesterol level is >240 mg/dL
___you don't know your cholesterol level
___you have a close relative who had a heart attack before age 55 (father or brother) or age 65 (mother or sister)
___you are diabetic or take medicine to control your blood sugar
___you are physically inactive (i.e. you get <30 minutes of physical activity at least 3 days/week)
___you are >20 pounds overweight

*If you have marked 2 or more of the statements in this section, consult your health care provider before engaging in exercise. You might benefit by using a facility with a professionally qualified exercise staff to guide your exercise program.*

___none of the above (section 1 and 2) is true

*You should be able to exercise safely without consulting your healthcare provider in almost any facility that meets your exercise program needs.*
# First line- self assessment, alternative 2

Table 2

**Revised physical activity readiness questionnaire (PAR-Q)**

(adopted from Balady, Circulation 1998;97:2283-93)

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Yes/ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Has a doctor ever said that you have a heart condition and recommended only medically supervised activity?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Do you have chest pain brought on by physical activity?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Have you developed chest pain in the past month?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Have you on 1 or more occasions lost consciousness or fallen over as a result of dizziness?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Do you have a bone or joint problem that could be aggravated by the proposed physical activity?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Has a doctor ever recommended medication for your blood pressure or a heart condition?</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>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?</td>
<td></td>
</tr>
</tbody>
</table>

Yes/ No
3. The fitness level adds info

Enhanced Risk Assessment in Asymptomatic Individuals With Exercise Testing and Framingham Risk Scores

Samia Mora, MD, MHS; Rita F. Redberg, MD, MSc; A. Richey Sharrett, MD, DrPH; Roger S. Blumenthal, MD

Background—National Cholesterol Education Program Adult Treatment Panel III (ATP III) guidelines recommend the use of Framingham risk scores (FRS) for cardiovascular assessment of asymptomatic individuals. We hypothesized that risk prediction could be improved with 2 non-ECG exercise test measures, exercise capacity (metabolic equivalents, or METs) and heart rate recovery (HRR).

Methods and Results—An asymptomatic cohort with baseline treadmill tests (n=6126; 46% women, FRS <20%) was followed up prospectively for 20 years. Individuals with low (median or less) HRR or METs experienced 91% of all cardiovascular disease (CVD) deaths (225/246). After FRS adjustment, low HRR and METs individually were highly significant predictors of CVD death, but low HRR and METs together were associated with substantially higher risk (adjusted hazard ratio compared with high HRR/high METs for women 8.51, 95% CI 3.65 to 19.84; for men, 3.53, 95% CI 2.03 to 6.15; P<0.001 for both). At 10-year follow-up, FRS-adjusted CVD death risk associated with low HRR/low METs was less than at 20 years but remained significant (women 3.83, 95% CI 1.09 to 13.47, and men 2.70, 95% CI 1.11 to 6.55). The application of HRR/METs information to FRS assessment identified those at high risk (>0.5% annual CVD mortality) in half of women with FRS 6% to 9% and 10% to 19% and just under half of men with FRS 10% to 19%. Low HRR/low METs was also associated with an increased relative risk of CVD death in individuals with low-risk FRS (FRS <6% in women and <10% in men), but absolute CVD mortality rates were low in this subgroup.

Conclusions—Exercise testing may be a useful adjunct for clinical risk assessment in asymptomatic women with FRS 6% to 19% and men with FRS 10% to 19%. (Circulation. 2005;112:1566-1572.)

Key Words: exercise ■ prevention ■ prognosis ■ risk factors
Regular physical exercise diminishes the acute risk of sudden death from cardiac causes by vigorous exertion.
Figure 2. Relative risk of MI associated with vigorous exertion (≥6 METs) according to habitual frequency of vigorous exertion. The T bars indicate 95% confidence limits. The dotted line indicates risk of MI with no prior vigorous exertion. Adapted from Mittleman,41 with permission from Blackwell Publishing.

(Circulation. 2007;115:2358-2368.)
Evaluation protocol for asymptomatic sedentary adult/senior individuals

What activity intended?

Low: self assessment

NO- eligible
YES- screening by physician

Moderate-high: screening by physician

Borjesson et al, EJCP 2010, acc
Evaluation protocol for asymptomatic active adult/senior individuals

What activity intended?

low- moderate- high intensity

Low: eligible

Moderate: self-assessment of risk

NO: eligible

YES: screening by physician

High: screening by physician

Assessment of risk (self- or by non physician)

Low intensity activity

Moderate - High intensity activity

Screening by physician
- History
- Phys. Exam.
- Risk Score
- Rest ECG

Further evaluation, appropriate treatment and individually prescribed PA

Maximal exercise testing

Eligible for exercise training

Borjesson et al, EJCPR 2010, acc
Position Paper

ESC Study Group of Sports Cardiology: recommendations for participation in leisure-time physical activity and competitive sports for patients with ischaemic heart disease
Mats Börjesson\(^a\), Deodato Assanelli\(^b\), François Carré\(^c\), Dorian Dugmore\(^d\), Nicole M. Panhuysen-Goedkoop\(^e\), Christian Seiler\(^f\), Jeff Senden\(^g\) and Erik E. Solberg\(^h\)

\(^a\)Department of Medicine, Sahlgrens University Hospital/Östra, Göteborg, Sweden, \(^b\)Department of Medicine, University of Brescia, Italy, \(^c\)Unité Biologie et Médecine du Sport, Hôpital Pontchaillou, Rennes, France, \(^d\)Wellness Medical Center, Stockport, UK, \(^e\)Heart Centre Radboud University Hospital Nijmegen and Cardiac Rehabilitation and Department of Sportscardiology St Maartenskliniek, Nijmegen, The Netherlands, \(^f\)Department of Cardiology, University Hospital, Bern, Switzerland, \(^g\)Department of Cardiology, Meander Medisch Centrum, Amersfoort, The Netherlands and \(^h\)Department of Medicine, Diakonhjemmet Hospital, Oslo, Norway.

Received 29 July 2005 Accepted 1 December 2005

High risk profile-SCORE>5%

• FIRST, try to rule out silent ischemia by maximal exercise testing (limitations)
• THEN…separate

1. Negative X-test: The absolute risk is considered low

2. Positive X-test: The risk for future cardiac events is increased (ref: MRFIT 15x/5x, Seattle Heart Watch, 30x)

⇒Further evaluation by stress echo/myocardial scintigraphy and/or coronary angiography to rule out/confirm the presence of IHD is needed

• Cardiac CT and/or cardiac MRI may be alternative!
The middle aged athletes of Vasaloppet?

1970-2005: 698,000 racers, 13 SCD (expected 1.7) -1/50,000 racers
73500 competitors in Vasaloppet 1989-98, mean 4 year follow-up

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Standardized mortality ratios (SMR) and 95% confidence intervals (CI) of all causes of death amongst men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of deaths</td>
<td>Observed</td>
</tr>
<tr>
<td>All</td>
<td>339</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>16–30</td>
<td>31</td>
</tr>
<tr>
<td>31–40</td>
<td>30</td>
</tr>
<tr>
<td>41–50</td>
<td>82</td>
</tr>
<tr>
<td>51+</td>
<td>196</td>
</tr>
<tr>
<td>Successful races (n)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>181</td>
</tr>
<tr>
<td>2–3</td>
<td>102</td>
</tr>
<tr>
<td>4–5</td>
<td>34</td>
</tr>
<tr>
<td>6+</td>
<td>22</td>
</tr>
</tbody>
</table>
Vasaloppet - net effect...

73,500 skiers
1989-98

3 extra SCD during the race

440 less deaths in 4 years follow-up after the race
Screening is no substitute for proper cardiovascular safety at sports events and arenas...
Yes,
Individualized PPE may play a role in middle aged athletes!