



EUROPEAN FEDERATION OF SPORTS MEDICINE ASSOCIATIONS  
9<sup>th</sup> European Congress on Sports Medicine

**EFSMA 2015 CONGRESS**

September 10 - 12, 2015  
Antwerp, Belgium



# ECG of special classes of athletes

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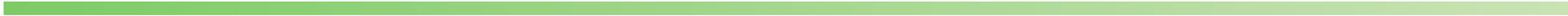


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European Association for Cardiovascular Prevention & Rehabilitation (EACPR)

A Registered Branch of the ESC





# Young athletes



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**Section of Sports Cardiology**  
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# ESC screening recommendations

young competitive athletes

family and personal history, physical examination, 12-lead ECG

negative findings

findings

eligibility for competition

evidence

further examinations  
echo, stress test, 24-h Holter, cardiac MRI, angio/EMB, EPS)

cardiovascular

management according to established protocols

*Corrado et al, Eur Heart J 2005*

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# Criteria for ECG interpretation

European Heart Journal Advance Access published December 22, 2009



European Heart Journal  
doi:10.1093/eurheartj/ehp473

ESC REPORT

## Recommendations for interpretation of 12-lead electrocardiogram in the athlete

**Domenico Corrado<sup>1\*</sup>, Antonio Pelliccia<sup>2</sup>, Hein Heidbuchel<sup>3</sup>, Sanjay Sharma<sup>4</sup>, Mark Link<sup>5</sup>, Cristina Basso<sup>6</sup>, Alessandro Biffi<sup>2</sup>, Gianfranco Buja<sup>1</sup>, Pietro Delise<sup>7</sup>, Ihor Gussac<sup>8</sup>, Aris Anastasakis<sup>9</sup>, Mats Borjesson<sup>10</sup>, Hans Halvor Bjørnstad<sup>11</sup>, François Carrè<sup>12</sup>, Asterios Deligiannis<sup>13</sup>, Dorian Dugmore<sup>14</sup>, Robert Fagard<sup>3</sup>, Jan Hoogsteen<sup>15</sup>, Klaus P. Mellwig<sup>16</sup>, Nicole Panhuyzen-Goedkoop<sup>17</sup>, Erik Solberg<sup>18</sup>, Luc Vanhees<sup>3</sup>, Jonathan Drezner<sup>19</sup>, N.A. Mark Estes, III<sup>5</sup>, Sabino Iliceto<sup>1</sup>, Barry J. Maron<sup>20</sup>, Roberto Peidro<sup>21</sup>, Peter J. Schwartz<sup>22</sup>, Ricardo Stein<sup>23</sup>, Gaetano Thiene<sup>6</sup>, Paolo Zeppilli<sup>24</sup>, and William J. McKenna<sup>25</sup> on behalf of the Sections of Sports Cardiology of the European Association of Cardiovascular Prevention and Rehabilitation; and the Working Group of Myocardial and Pericardial Disease of the European Society of Cardiology**



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# Meta-analysis



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)

## The 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>

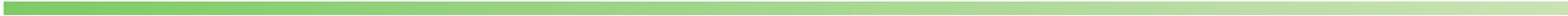
<sup>a</sup> Department of Family Medicine, University of Washington, Seattle, WA, USA

<sup>b</sup> Department of Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA

Meta-analysis of pooled data.

	ECG	History	Physical
Sensitivity	94% (79%–98%)	20% (7%–44%)	9% (3%–24%)
Specificity	93% (90%–96%)	94% (89%–96%)	97% (95%–98%)
Positive likelihood ratio*	14.8 (9.43–23.16)	3.22 (1.3–8.01)	2.93 (1.26–6.83)
Negative likelihood ratio*	0.055 (0.012–0.25)	0.85 (0.68–1.07)	0.93 (0.85–1.03)

\*Interpretation of likelihood ratios



# Different ethnicity and gender?



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## Electrocardiographic interpretation in athletes: the 'Seattle Criteria'

Jonathan A Drezner,<sup>1</sup> Michael John Ackerman,<sup>2</sup> Jeffrey Anderson,<sup>3</sup> Euan Ashley,<sup>4</sup> Chad A Asplund,<sup>5</sup> Aaron L Baggish,<sup>6</sup> Mats Börjesson,<sup>7</sup> Bryan C Cannon,<sup>8</sup> Domenico Corrado,<sup>9</sup> John P DiFiori,<sup>10</sup> Peter Fischbach,<sup>11</sup> Victor Froelicher,<sup>4</sup> Kimberly G Harmon,<sup>1</sup> Hein Heidbuchel,<sup>12</sup> Joseph Marek,<sup>13</sup> David S Owens,<sup>14</sup> Stephen Paul,<sup>15</sup> Antonio Pelliccia,<sup>16</sup> Jordan M Prutkin,<sup>14</sup> Jack C Salerno,<sup>17</sup> Christian M Schmied,<sup>18</sup> Sanjay Sharma,<sup>19</sup> Ricardo Stein,<sup>20</sup> Victoria L Vetter,<sup>21</sup> Mathew G Wilson<sup>22</sup>

This document was developed in collaboration between the American Medical Society for Sports Medicine (AMSSM), the Section on Sports Cardiology of the European Association for Cardiovascular Prevention and Rehabilitation (EACPR), a registered branch of the European Society of Cardiology (ESC), the FIFA Medical Assessment and Research Center (F-MARC), and the Pediatric & Congenital Electrophysiology Society (PACES).

**OBS!**

### Additional resources

For a free online training module on ECG interpretation in athletes, please visit: <http://learning.bmj.com/ECGathlete>



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## Part 3?

# Comparison of Electrocardiographic Criteria for the Detection of Cardiac Abnormalities in Elite Black and White Athletes

Nabeel Sheikh, MRCP; Michael Papadakis, MRCP; Saqib Ghani, MRCP; Abbas Zaidi, MRCP; Sabiha Gati, MRCP; Paolo Emilio Adami, MD; François Carré, PhD; Frédéric Schnell, PhD; Mathew Wilson, PhD; Paloma Avila, MD; William McKenna, MD, DSc, FESC; Sanjay Sharma, MD, FRCP, FESC (UK)

**Background**—Recent efforts have focused on improving the specificity of the European Society of Cardiology (ESC) criteria for ECG interpretation in athletes. These criteria are derived predominantly from white athletes (WAs) and do not account for the effect of Afro-Caribbean ethnicity or novel research questioning the relevance of several isolated ECG patterns. We assessed the impact of the ESC criteria, the newly published Seattle criteria, and a group of proposed refined criteria in a large cohort of black athletes (BAs) and WAs.

**Methods and Results**—Between 2000 and 2012, 1208 BAs were evaluated with history, examination, 12-lead ECG, and further investigations as appropriate. ECGs were retrospectively analyzed according to the ESC recommendations, Seattle criteria, and proposed refined criteria which exclude several specific ECG patterns when present in isolation. All 3 criteria were also applied to 4297 WAs and 103 young athletes with hypertrophic cardiomyopathy. The ESC recommendations raised suspicion of a cardiac abnormality in 40.4% of BAs and 16.2% of WAs. The Seattle criteria reduced abnormal ECGs to 18.4% in BAs and 7.1% in WAs. The refined criteria further reduced abnormal ECGs to 11.5% in BAs and 5.3% in WAs. All 3 criteria identified 98.1% of athletes with hypertrophic cardiomyopathy. Compared with ESC recommendations, the refined criteria improved specificity from 40.3% to 84.2% in BAs and from 73.8% to 94.1% in WAs without compromising the sensitivity of the ECG in detecting pathology.

**Conclusion**—Refinement of current ECG screening criteria has the potential to significantly reduce the burden of false-positive ECGs in athletes, particularly BAs. (*Circulation*. 2014;129:1637-1649.)



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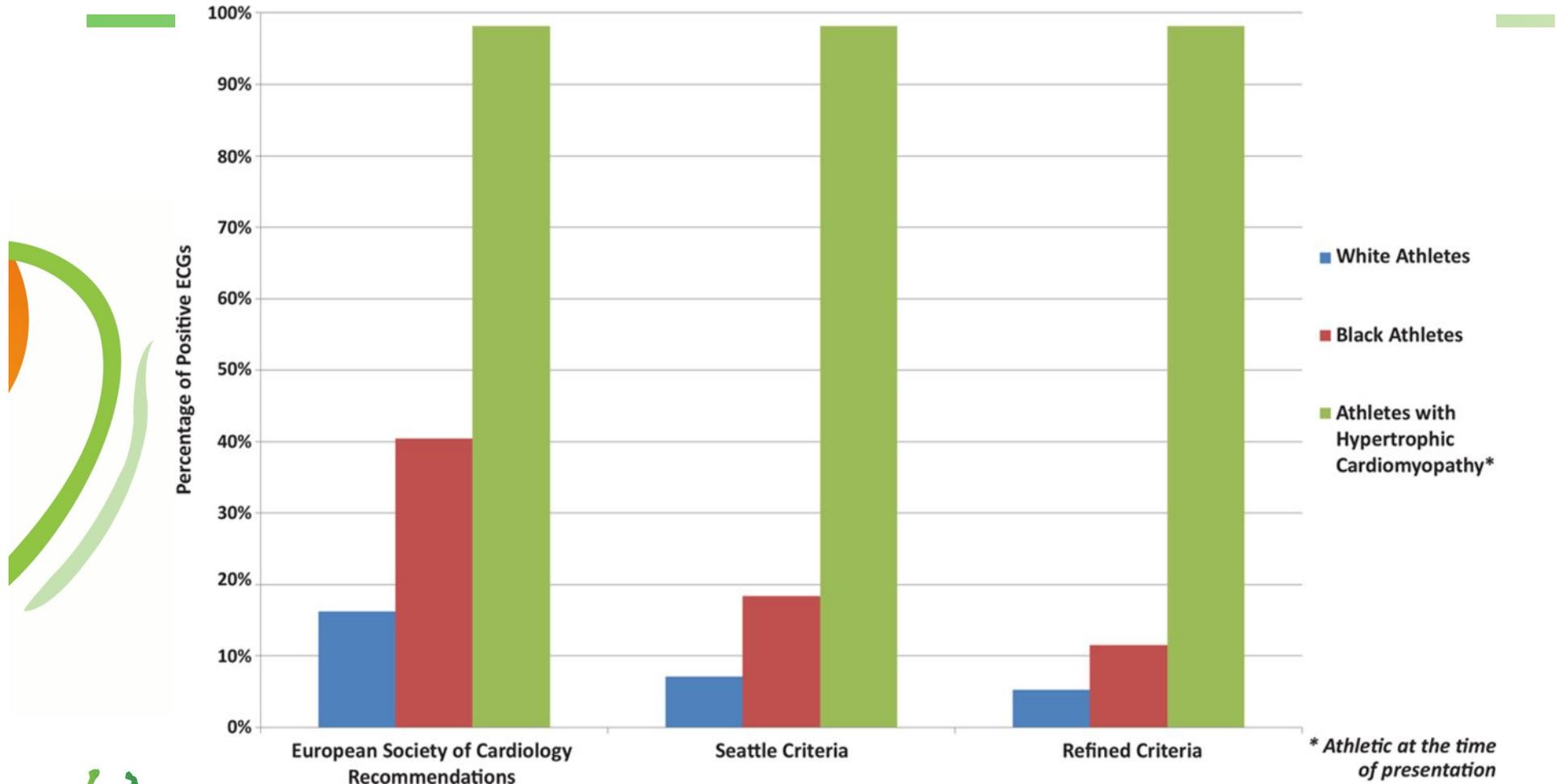
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## The number of positive ECGs produced by the 3 different ECG screening criteria.



Sheikh N et al. Circulation. 2014;129:1637-1649

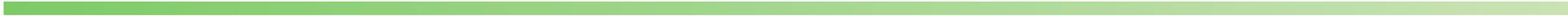


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# Older population



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# MAMILS

- "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 cardiovascular disease" : AHA 2001*



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**TABLE 3. Physical Stress as a Trigger of Acute Cardiovascular Events During Vigorous Exertion\***

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

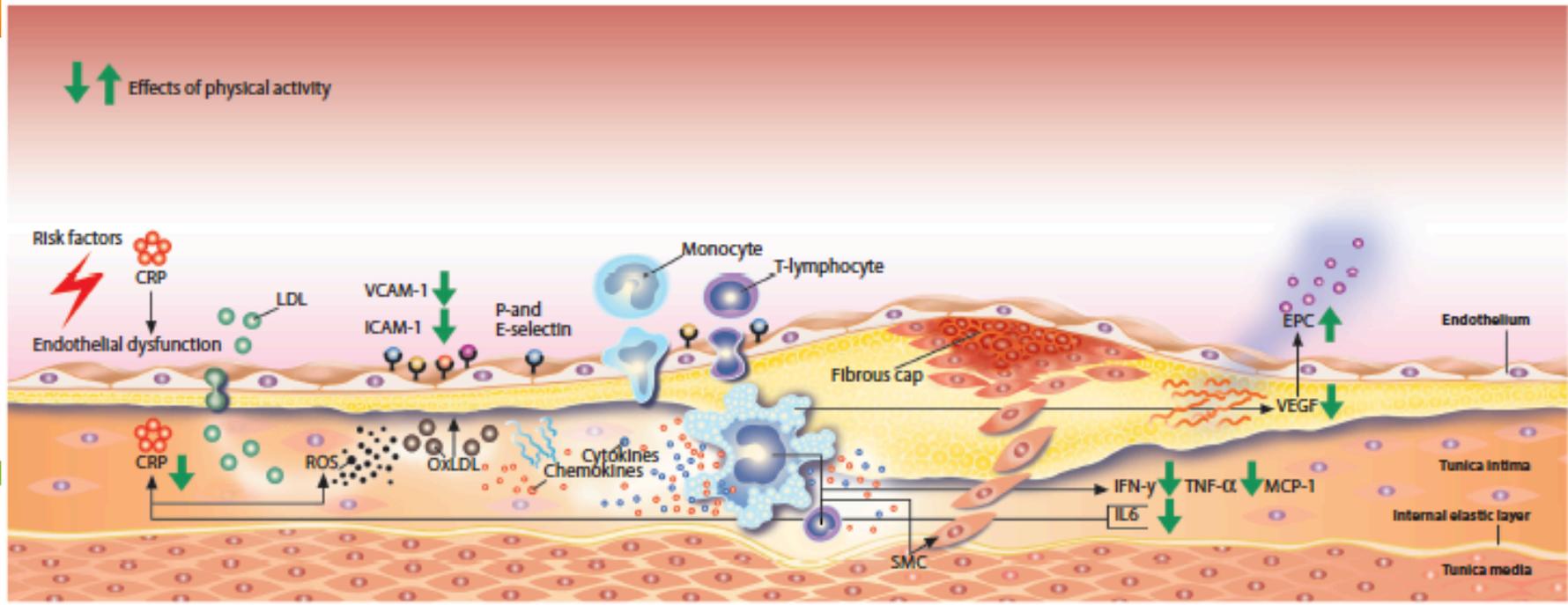
RR indicates relative risk and compares the risk of the cardiac event during exertion with that during sedentary activities; TRIMM, Triggers and Mechanisms of Myocardial Infarction Study; and SHEEP, Stockholm Heart Epidemiology Programme.

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

†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,<sup>41</sup> with permission from Blackwell Publishing.





- A. Risk factors:
  - smoking
  - diabetes
  - hypertension
  - lack of physical activity (PA)
- B. LDL enters the subendothelial space.
- C. LDL is oxidized by ROS and upregulates adhesion molecules and chemokines that recruit monocytes and T-lymphocytes.
- D. Monocytes differentiate to macrophages.
- E. Macrophages and T-lymphocytes produce cytokines and chemokines that stimulate SMC migration to the atherosclerotic plaque.
- F. IL-6 produces CRP that produces ROS and causes further endothelial dysfunction.
- G. Macrophages produce VEGF that lead to vessel formation within the atherosclerotic plaque and recruitment of EPC.

Fig:  
 Palmefors,..Borjesson,  
 Atherosclerosis 2014

- Atherosclerotic process underway
- Endothelial dysfunction
- Subclinical disease?...





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# Predictive power of ECG findings of CAD?





# Resting ECG predicts mortality

680

JACC Vol. 32, No. 3  
September 1998:680-5

## Prognostic Value of Ischemic Electrocardiographic Findings for Cardiovascular Mortality in Men and Women

DIRK DE BACQUER, MSc,\* GUY DE BACKER, MD, PhD, FACC,\*

MARCEL KORNITZER, MD, PhD,† KATRIEN MYNY, MD,\* ZOE DOYEN, MD,†

HENRY BLACKBURN, MD, PhD, FACC‡

*Ghent and Brussels, Belgium and Minneapolis, Minnesota*

**Belgian Interuniversity research on nutrition and health study  
n= 4797 men and 4320 women, age 25-74 years  
Excluded Q-wave evidence of an old MI.  
10-year follow-up**



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# Review of resting ECG changes

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Annals of Internal Medicine

REVIEW



## Screening Asymptomatic Adults With Resting or Exercise Electrocardiography: A Review of the Evidence for the U.S. Preventive Services Task Force

Roger Chou, MD; Bhaskar Arora, MD; Tracy Dana, MLS; Rongwei Fu, PhD; Miranda Walker, MA; and Linda Humphrey, MD

*Ann Intern Med.* 2011;155:375-385.



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# ECG predictors of CV events

**Table 1. Summary of Pooled Risk Estimates for Subsequent Cardiovascular Events With Abnormalities on Resting**

Type of ECG and Abnormality	Studies (References), <i>n</i>	Pooled Adjusted HR (95% CI)
<b>Resting ECG</b>		
ST-segment abnormalities	5 (27, 29, 33, 36, 39)	1.9 (1.4–2.5)
T-wave abnormalities	6 (27, 29, 33, 39, 45)	1.6 (1.3–1.8)
ST-segment or T-wave abnormalities	7 (28, 31, 33, 41, 42, 49, 50)	1.9 (1.6–2.4)
Left ventricular hypertrophy	8 (24, 25, 29, 35, 36, 39, 41, 50)	1.6 (1.3–2.0)
Bundle branch block	4 (29, 39, 41, 42, 67, 68, 69)	1.5 (0.98–2.3)
Left-axis deviation	3 (29, 41, 50)	1.5 (1.1–1.9)

n=173 710 resting ECGs, from studies on asymptomatic individuals

*Ann Intern Med.* 2011;155:375-385.





# Evaluation of older athletes

Review

European Journal of  
**Cardiovascular  
Prevention &  
Rehabilitation**



## **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**

European Journal of Cardiovascular  
Prevention & Rehabilitation  
18(3) 446–458  
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Cardiology 2011  
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DOI: 10.1177/HJR.0b013e328333bo969  
ejpr.sagepub.com



**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>**



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# Individuals with different diseases



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# Exercise prescription for chronic disease

”If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health”

(Hippocrates 400 BC)

ETT FÖREBYGGANDE RECEPT

Enligt Läk. nr 2000:100 och nr 2000:101, men ej kan tilläggas

Patienten: \_\_\_\_\_

Titel: BIL. JON. INTE FÖR PÅ BIL!

L = Långsiktig träning  
R = Rehabiliteringsövning  
V = Vitaliserande övning

☐ Läkemedelsrecept

Läkare: \_\_\_\_\_

ADRESS: \_\_\_\_\_

TRÄNING: 1-2 GÅNGER I VECKAN FÖR ATT ÅTERVUNNA URSÄKT OCH ÅTER GÅ RÅDE

☐ Föreläggande

FRÖLUNDA FITNESS CENTER

Kontrollgatan 7, 416 00 Göteborg • Telefon: 031-470000

RECEPTET ÄR BEGRÄNSAT GÄLLANDE PERIODALEN! Gäller från 5/12-02





Review

## Importance of characteristics and modalities of physical activity and exercise in defining the benefits to cardiovascular health within the general population: recommendations from the EACPR (Part I)

L Vanhees<sup>1</sup>, J De Sutter<sup>2</sup>, N Geladas<sup>3</sup>, F Doyle<sup>4</sup>, E Prescott<sup>5</sup>, V Cornelissen<sup>1</sup>, E Kouidi<sup>6</sup>, D Dugmore<sup>7</sup>, D Vanuzzo<sup>8</sup>, M Börjesson<sup>9</sup>, P Doherty<sup>10</sup> (on behalf of the writing group of the EACPR)

European Journal of Preventive  
Cardiology  
0(0) 1–17  
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Cardiology 2012  
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DOI: 10.1177/2047487312437059  
ejpc.sagepub.com  


# Different approaches

Review

## Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors: recommendations from the EACPR (Part II)

L Vanhees<sup>1</sup>, N Geladas<sup>2</sup>, D Hansen<sup>3</sup>, E Kouidi<sup>4</sup>, J Niebauer<sup>5</sup>, Ž Reiner<sup>6</sup>, V Cornelissen<sup>1</sup>, S Adamopoulos<sup>7</sup>, E Prescott<sup>8</sup> and M Börjesson<sup>9</sup> (on behalf of the writing group)

European Journal of Cardiovascular  
Prevention & Rehabilitation  
0(0) 1–29  
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Cardiology 2011  
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sagepub.co.uk/journalsPermissions.nav  
DOI: 10.1177/1741826711430926  
ejcpr.sagepub.com  


Review

## Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular disease (Part III)

L Vanhees<sup>1</sup>, B Rauch<sup>2</sup>, M Piepoli<sup>3</sup>, F van Buuren<sup>4</sup>, T Takken<sup>5</sup>, M Börjesson<sup>6</sup>, B Bjarnason-Wehrens<sup>7</sup>, P Doherty<sup>8</sup>, D Dugmore<sup>9</sup> and M Halle<sup>10</sup> (on behalf of the writing group of the EACPR)

European Journal of Preventive  
Cardiology  
0(0) 1–24  
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DOI: 10.1177/2047487312437063  
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# High intensity training

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Possibly a higher yield,  
But  
definitely a need to be personalized,  
to achieve the  
added benefits at the lowest risk





# Individualised prescription

- \*Counselling by the health care professional
- \*Resulting in an individualised prescription



*Indication*

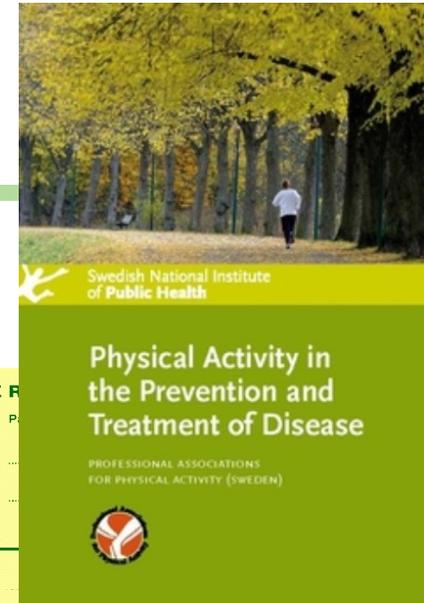
*Mode of action*

*Dosage*

*(type of activity, intensity, frequency)*

*Side-effects*

*Contra-indications*



ETT FÖREBYGGANDE RECEPT

Evigt Liv, nej det kan vi inte lova, men vi kan höja oddsen!

Re: träning är:

**L** = Långsiktig träning  
**R** = Regelbunden träning  
**V** = Varierad träning

Läkemedelsnamn  
**TRÄNING**

Läkemedelsform

**MOTION** VALPRI 1-2 GGR/V

Dosering, användning, används

**TRÄNING 1-2 GÅNGER I VECKAN FÖR ATT FÖREBYGGA OHÄLSA. SKALL INTAGAS LÅNGSIKTIGT, REGELBUNDEN, VARIERAT OCH MED GLÄDJE.**

Erbjudande

SKRIV IN DIG I SOMMAR SÅ BJUDER VI PÅ ETT HÖGKOSTNADSSKYDD. Dessutom får du CMS TRAVELPASS SOM GER DIG RÄTTEN ATT TRÄNA GRATIS PÅ ÖVER 120 ANLÄGGNINGAR I NORDEN SAMT I USA, CANADA, AUSTRALIEN, RYSSLAND MED FLERA.

VILL DU VETA MERA OM VÅRT ERBJUDANDE, RING NU!

Receptutfärdarens namn, adress och telefonnummer

**FRÖLUNDA FITNESS CENTER**

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Hälsning

HJÄRTLIGT VÄLKOMMEN ÖNSKAR PERSONALEN!

Ordspråk av Edward Stanley  
 De som tror att de inte har tid med fysisk aktivitet måste för en senare avsätta tid för sjukdom.

Gäller tom  
 31/8-02

Receptet kan ej kombineras med andra recept.





# Individualised prescription

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- Disease/disorder where PA may have effect
- Identify type/dose/intensity of PA ([www.fyss.se](http://www.fyss.se))
- Consider individual factors
  - risk profile
  - medications
  - habitual exercise/fitness
- Additional testing
  - Testing? ECG? X-test?
- Adjustment of the prescription



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