Prevalence and clinical correlates of ECG patterns in adolescent athletes.

Filippo M. Quattrini, MD, PhD

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Italian National Olympic Committee

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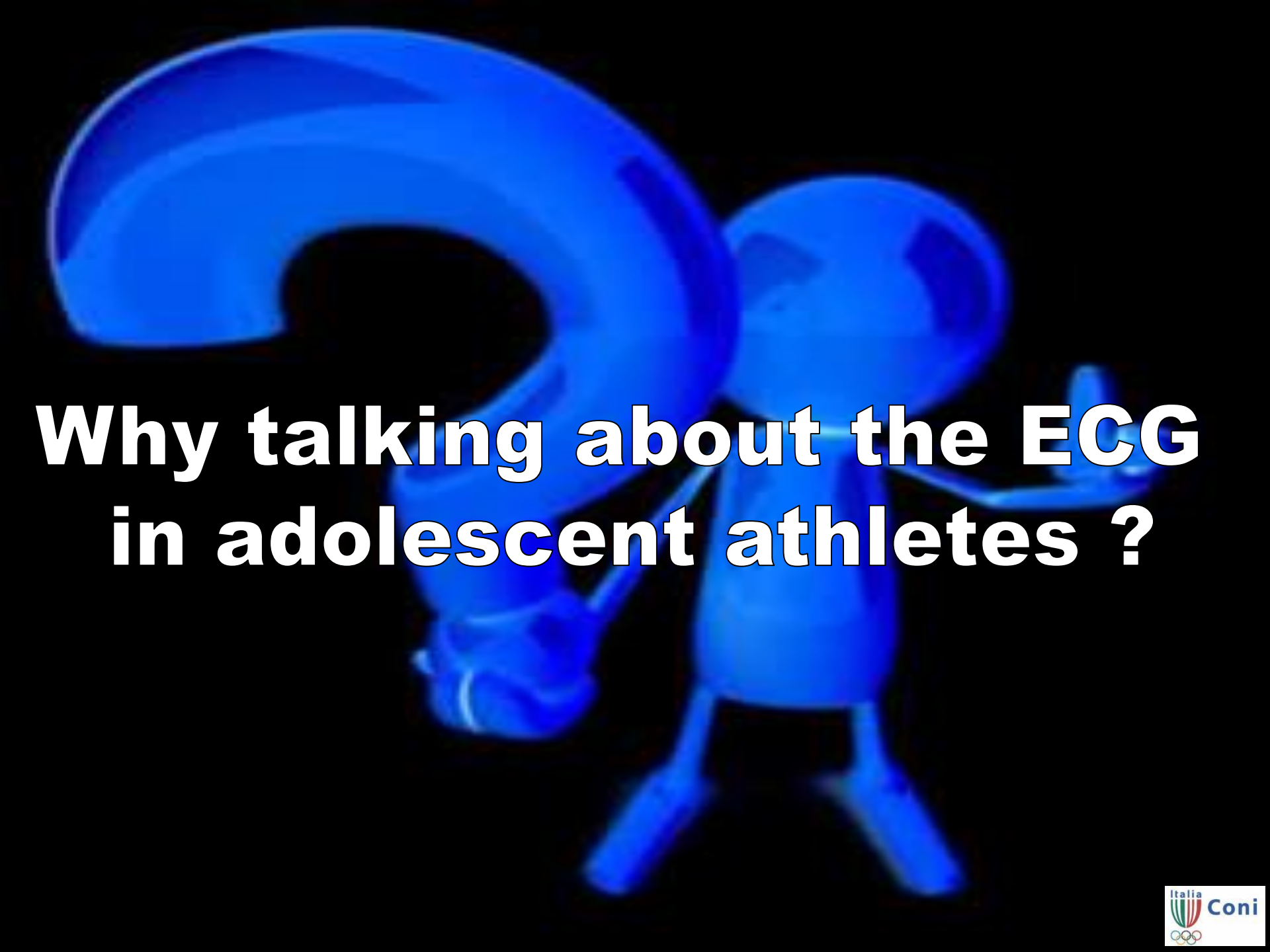
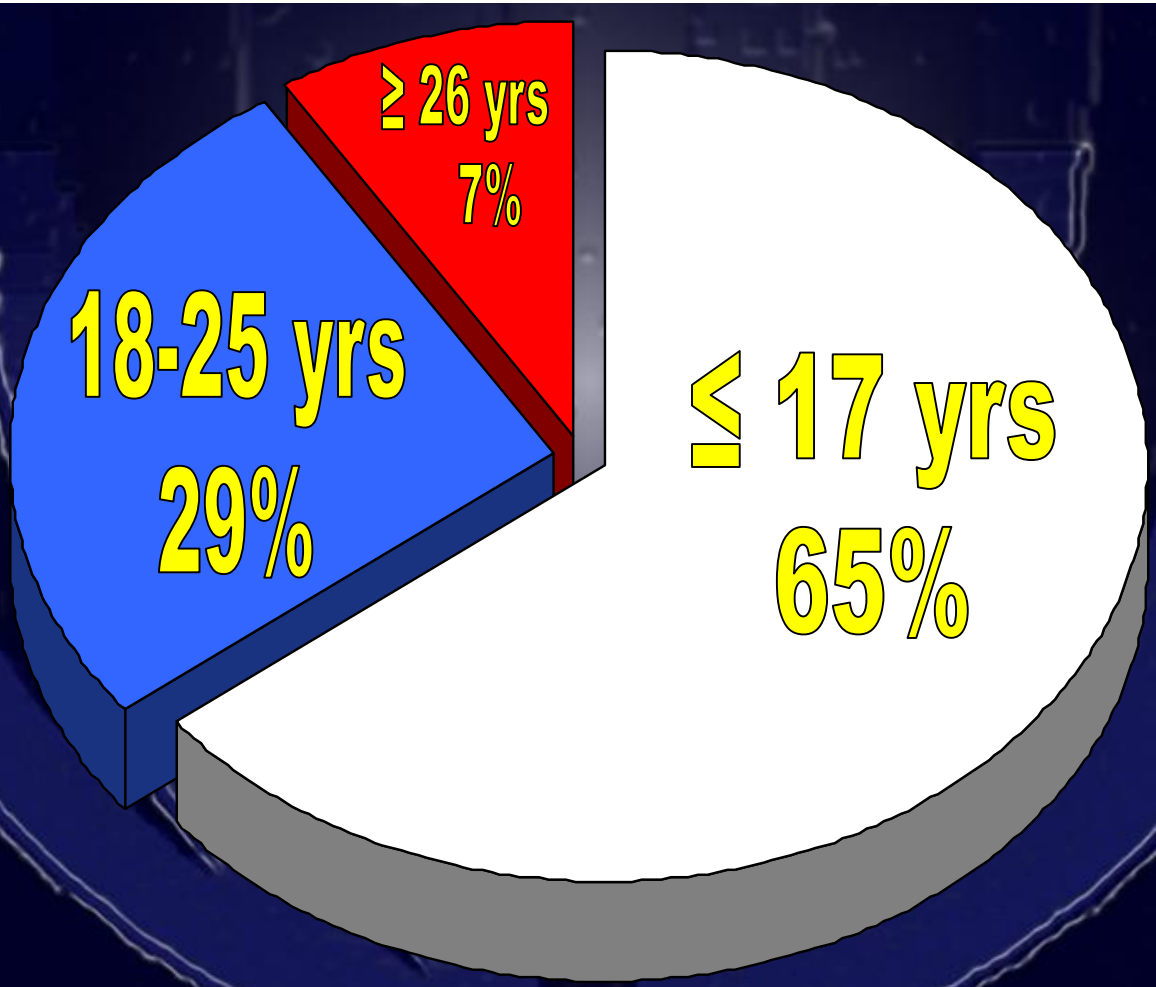


Why talking about the ECG in adolescent athletes ?

Sudden Deaths in Young Competitive Athletes

Analysis of 1866 Deaths in the United States, 1980–2006

Barry J. Maron, MD; Joseph J. Doerer, BS; Tammy S. Haas, RN;
David M. Tierney, MD; Frederick O. Mueller, PhD



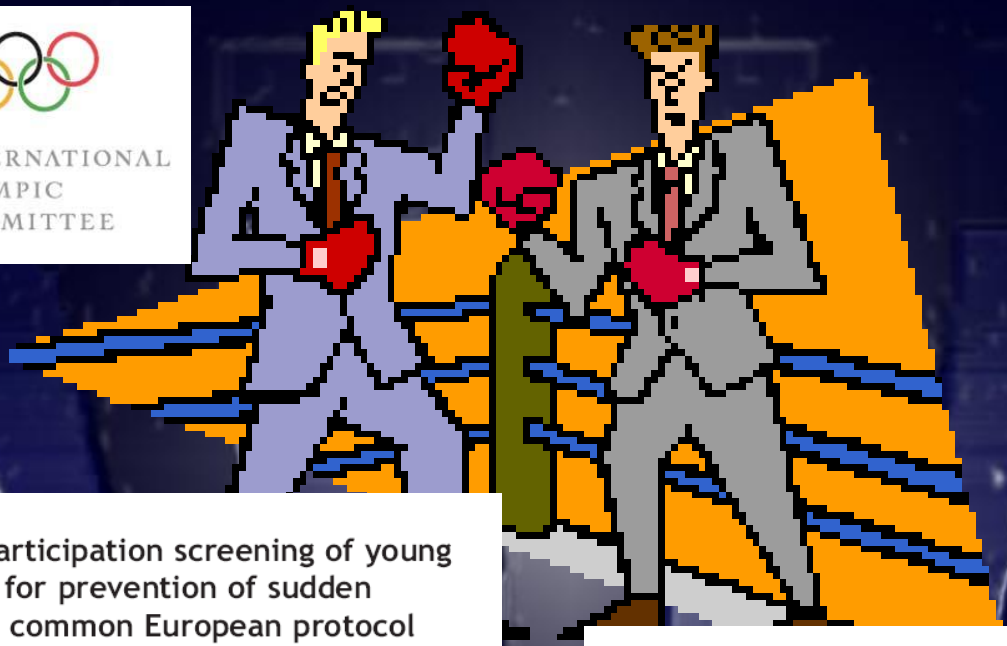
Adapted from Maron BJ et al Circulation. 2009;119:1085-1092

The great debate

EUROPEAN SOCIETY OF CARDIOLOGY

INTERNATIONAL OLYMPIC COMMITTEE

American Heart Association. *Learn and Live.*



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

Sudden Cardiovascular Death in Sport

LAUSANNE RECOMMENDATIONS

Under the umbrella IOC Medical Commission
10 December 2004

PREPARTICIPATION CARDIOVASCULAR SCREENING

Recommendations and Considerations Related to Preparticipation Screening for Cardiovascular Abnormalities in Competitive Athletes: 2007 Update: A Scientific Statement From the American Heart Association Council on Nutrition, Physical Activity, and Metabolism: Endorsed by the American College of Cardiology Foundation

Barry J. Maron, Paul D. Thompson, Michael J. Ackerman, Gary Balady, Stuart Berger, David Cohen, Robert Dimeff, Pamela S. Douglas, David W. Glover, Adolph M. Hutter, Jr, Michael D. Krauss, Martin S. Maron, Matthew J. Mitten, William O. Roberts and James C. Puffer

Circulation 2007;115;1643-1655; originally published online Mar 12, 2007;
DOI: 10.1161/CIRCULATIONAHA.107.181423

Circulation is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514

 Print ISSN: 0009-7322. Online ISSN: 1524-4539

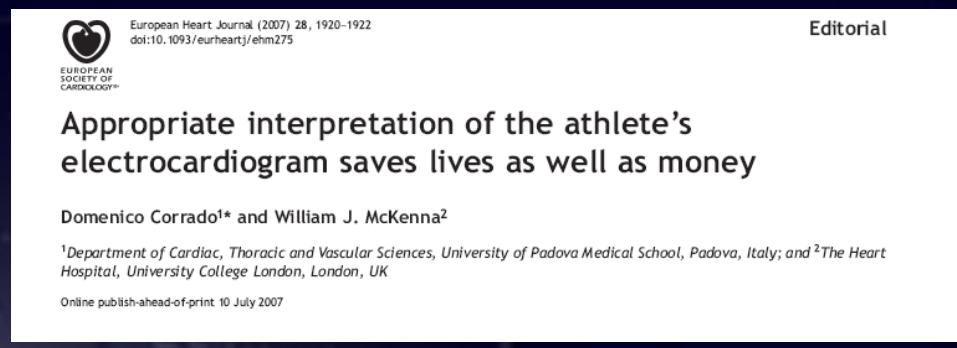
European Heart Journal (2007) 28, 2703–2705
doi:10.1093/eurheartj/ehm455

Current opir

The preparticipation cardiovascular screening of competitive athletes: is it time to change the customary clinical practice?

Antonio Pelliccia*

Institute of Sports Medicine and Science, Largo Piero Gabrielli 1.00197 Rome, Italy



European Heart Journal (2007) 28, 1920–1922
doi:10.1093/eurheartj/ehm275

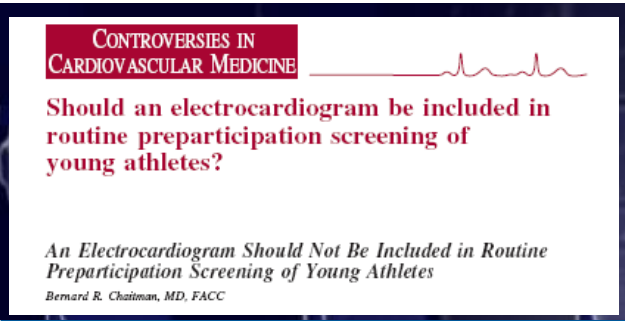
Editorial

Appropriate interpretation of the athlete's electrocardiogram saves lives as well as money

Domenico Corrado[1]* and William J. McKenna[2]

[1]*Department of Cardiac, Thoracic and Vascular Sciences, University of Padova Medical School, Padova, Italy; and* [2]*The Heart Hospital, University College London, London, UK*

Online publish-ahead-of-print 10 July 2007

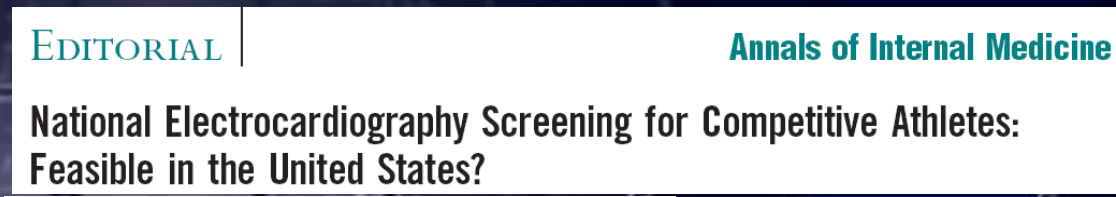


CONTROVERSIES IN CARDIOVASCULAR MEDICINE

Should an electrocardiogram be included in routine preparticipation screening of young athletes?

An Electrocardiogram Should Not Be Included in Routine Preparticipation Screening of Young Athletes

Bernard R. Chaitman, MD, FACC



EDITORIAL

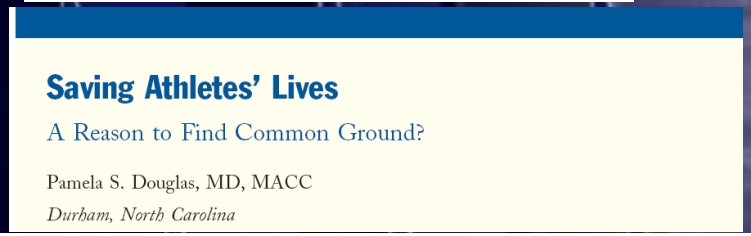
Annals of Internal Medicine

National Electrocardiography Screening for Competitive Athletes: Feasible in the United States?

CONTROVERSIES IN CARDIOVASCULAR MEDICINE

Electrocardiograms Should Be Screening of Athletes

Robert J. Myerburg, MD; Victoria L. Vetter, MD



Saving Athletes' Lives

A Reason to Find Common Ground?

Pamela S. Douglas, MD, MACC

Durham, North Carolina

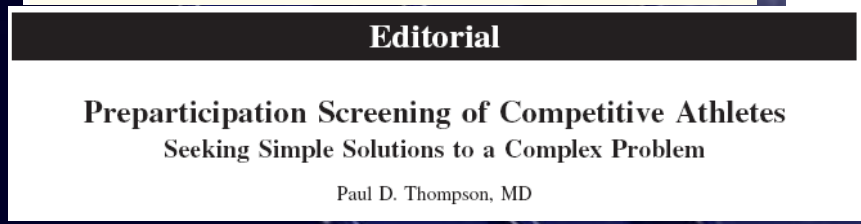
ELSEVIER

THE LANCET

Should be the electrocardiogram required in young athletes?

Chaitman B

Lancet 2008;371:1489-90

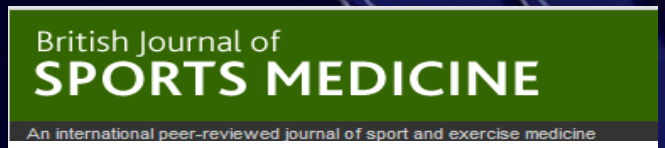


Editorial

Preparticipation Screening of Competitive Athletes

Seeking Simple Solutions to a Complex Problem

Paul D. Thompson, MD



British Journal of SPORTS MEDICINE

An international peer-reviewed journal of sport and exercise medicine

Electrocardiographic screening in athletes: the time is now for universal screening.

Papadakis M, Sharma S.

British Journal of SPORTS MEDICINE

An international peer-reviewed journal of sport and exercise medicine

Controversies relating to pre-participation cardiovascular screening in young athletes: Time for a realistic solution?

Papadakis M, Chandra N, Sharma S.

Italia Coni

ARTICLE | Annals of Internal Medicine

ARTICLE | Annals of Internal Medicine

Cost-Effectiveness of Preparticipation Screening for Prevention of Sudden Cardiac Death in Young Athletes

Matthew T. Wheeler, MD, PhD; Paul A. Heidenreich, MD, MS; Victor F. Froelicher, MD; Mark A. Hlatky, MD; and Euan A. Ashley, MB ChB, DPhil

Annals of Internal Medicine | ARTICLE

Cardiovascular Screening in College Athletes With and Without Electrocardiography

A Cross-sectional Study

Aaron L. Baggish, MD; Adolph M. Hutter Jr., MD; Francis Wang, MD; Kibar Yared, MD; Rory B. Weiner, MD; Eli Kupperman, BA; Michael H. Picard, MD; and Malissa J. Wood, MD

Annals of Internal Medicine | ARTICLE

Cardiovascular Screening in College Athletes With and Without Electrocardiography

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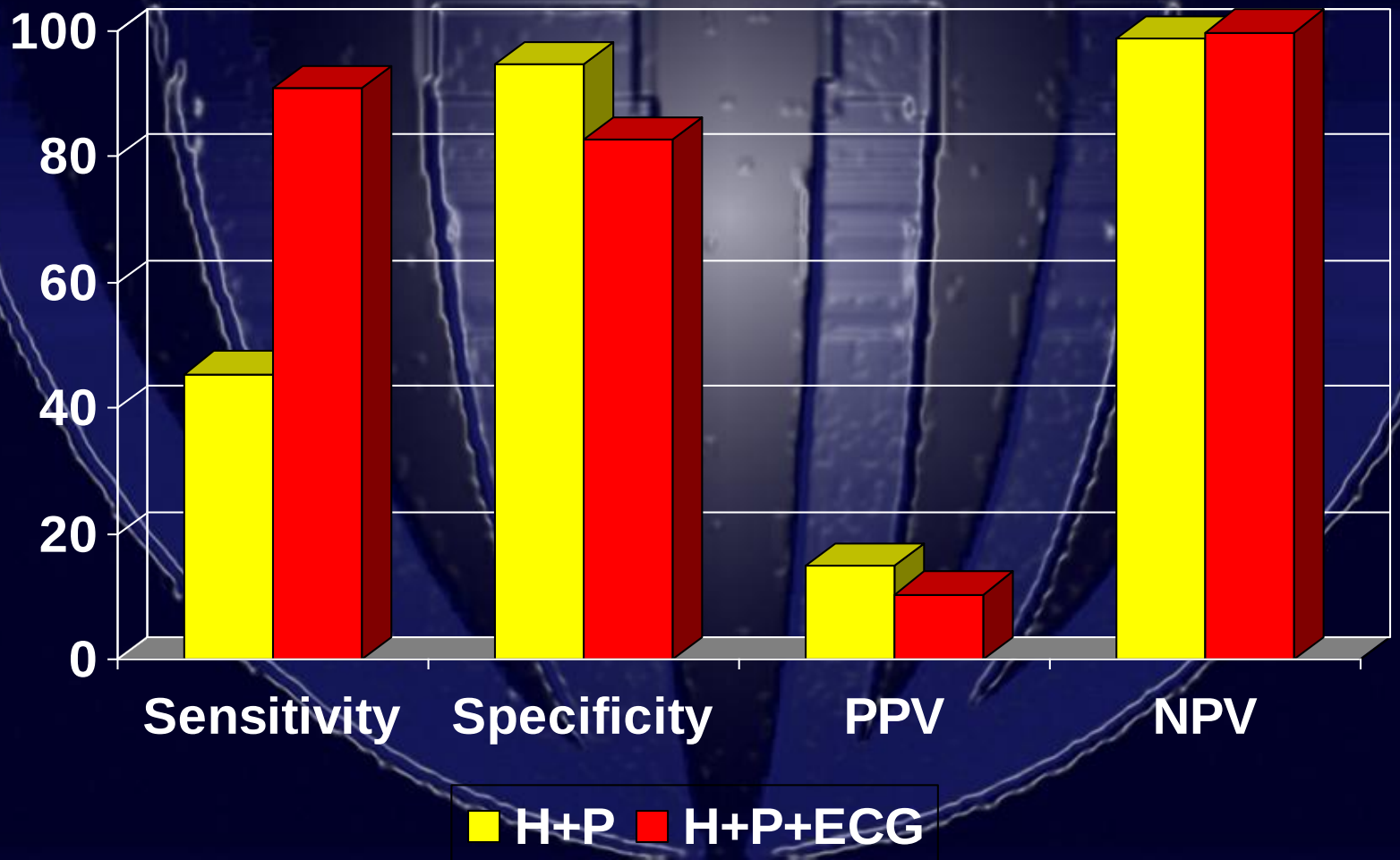
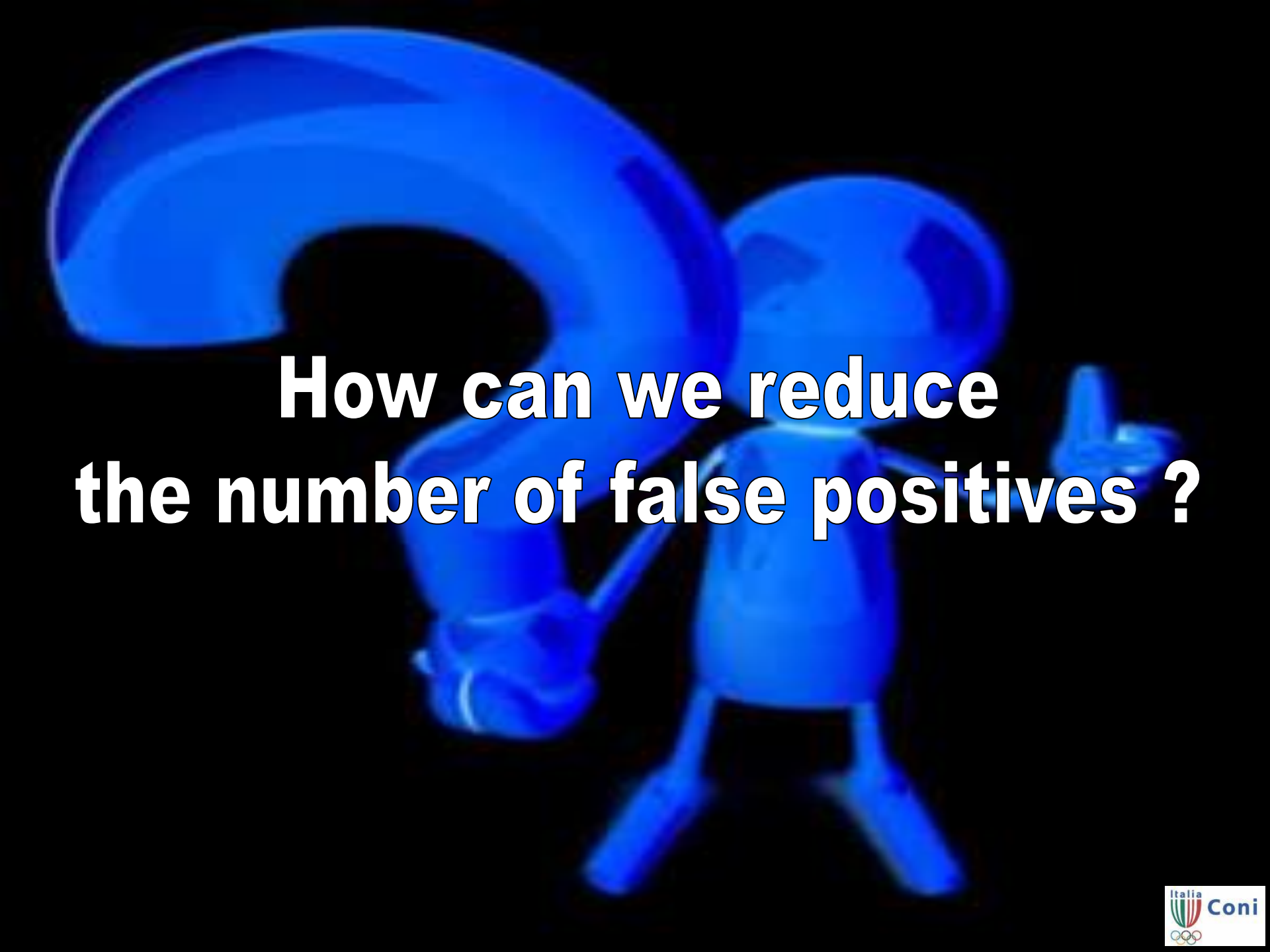



How can we reduce
the number of false positives ?

Common and training-related ECG changes

Uncommon and training-unrelated ECG changes

European Heart Journal
doi:10.1093/eurheartj/ehp473

ESC REPORT

Recommendations for interpretation of 12-lead electrocardiogram in the athlete

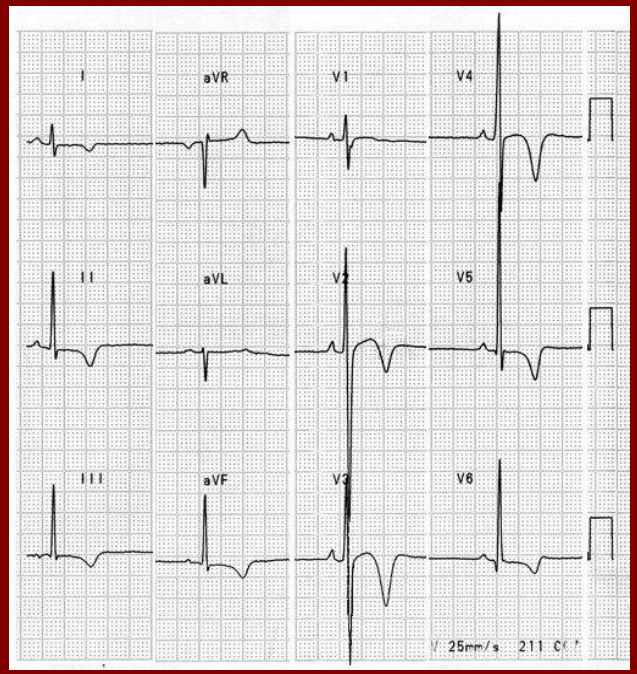
Domenico Corrado[1*], Antonio Pelliccia[2], Hein Heidbuchel[3], Sanjay Sharma[4], Mark Link[5], Cristina Basso[6], Alessandro Biffi[2], Gianfranco Buja[1], Pietro Delise[7], Ihor Gussac[8], Aris Anastasakis[9], Mats Borjesson[10], Hans Halvor Bjørnstad[11], François Carrè[12], Asterios Deligiannis[13], Dorian Dugmore[14], Robert Fagard[3], Jan Hoogsteen[15], Klaus P. Mellwig[16], Nicole Panhuyzen-Goedkoop[17], Erik Solberg[18], Luc Vanhees[3], Jonathan Drezner[19], N.A. Mark Estes, III[5], Sabino Iliceto[1], Barry J. Maron[20], Roberto Peidro[21], Peter J. Schwartz[22], Ricardo Stein[23], Gaetano Thiene[6], Paolo Zeppilli[24], and William J. McKenna[25] 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

or

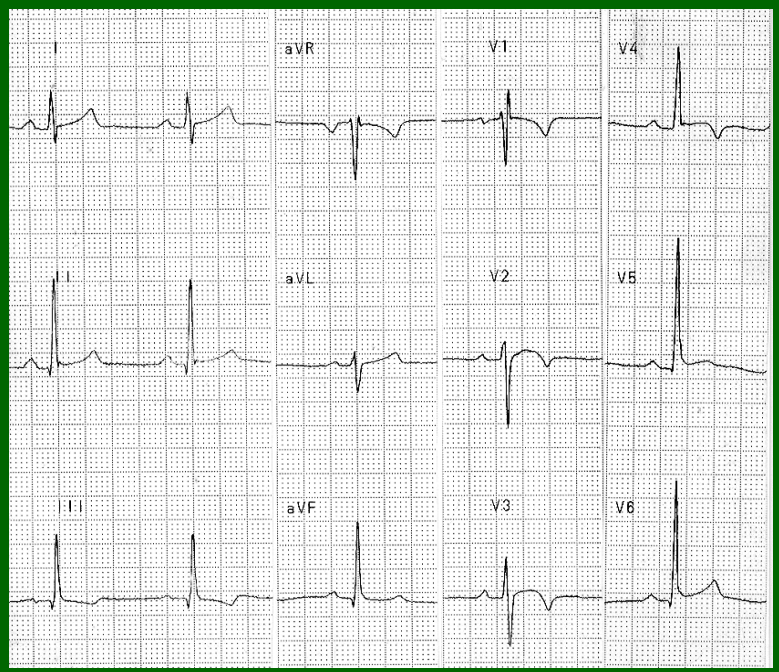
- Long or short QT interval
- Brugada like early repolarization

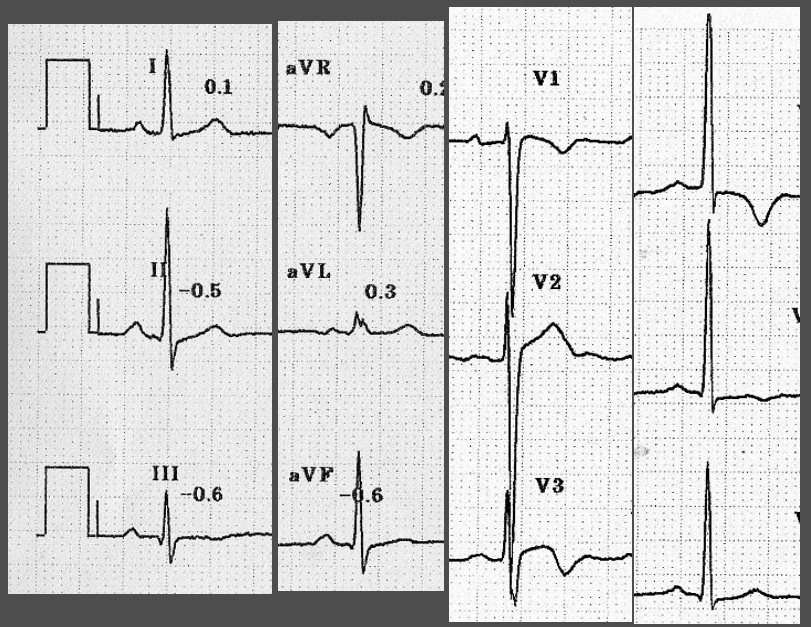
Prevalence of ECG changes in relation to age and level of achievement of athletes

	Adult Elite Athletes (n = 1,005) Pelliccia et al *Circulation 2000*	Amateur Athletes (n = 32,652) Pelliccia et al. *Eur Heart J 2007*	Junior Elite Athletes (n = 1,000) Sharma et al. *BJSM 1999*
Incomplete RBBB, PR interval > 0.20, early repolarization	34 %	7 %	29%, 5%, 43% respectively
Increased R/S wave voltages (LVH)	40 %	0.8 %	45 %
RBBB	0.2%	1%	0.6%
T wave inversion	2.7 %	2.3 %	4 %



***ECG abnormalities are present in up to 95 % of HCM patients* and > 80% of ARVC patients.**





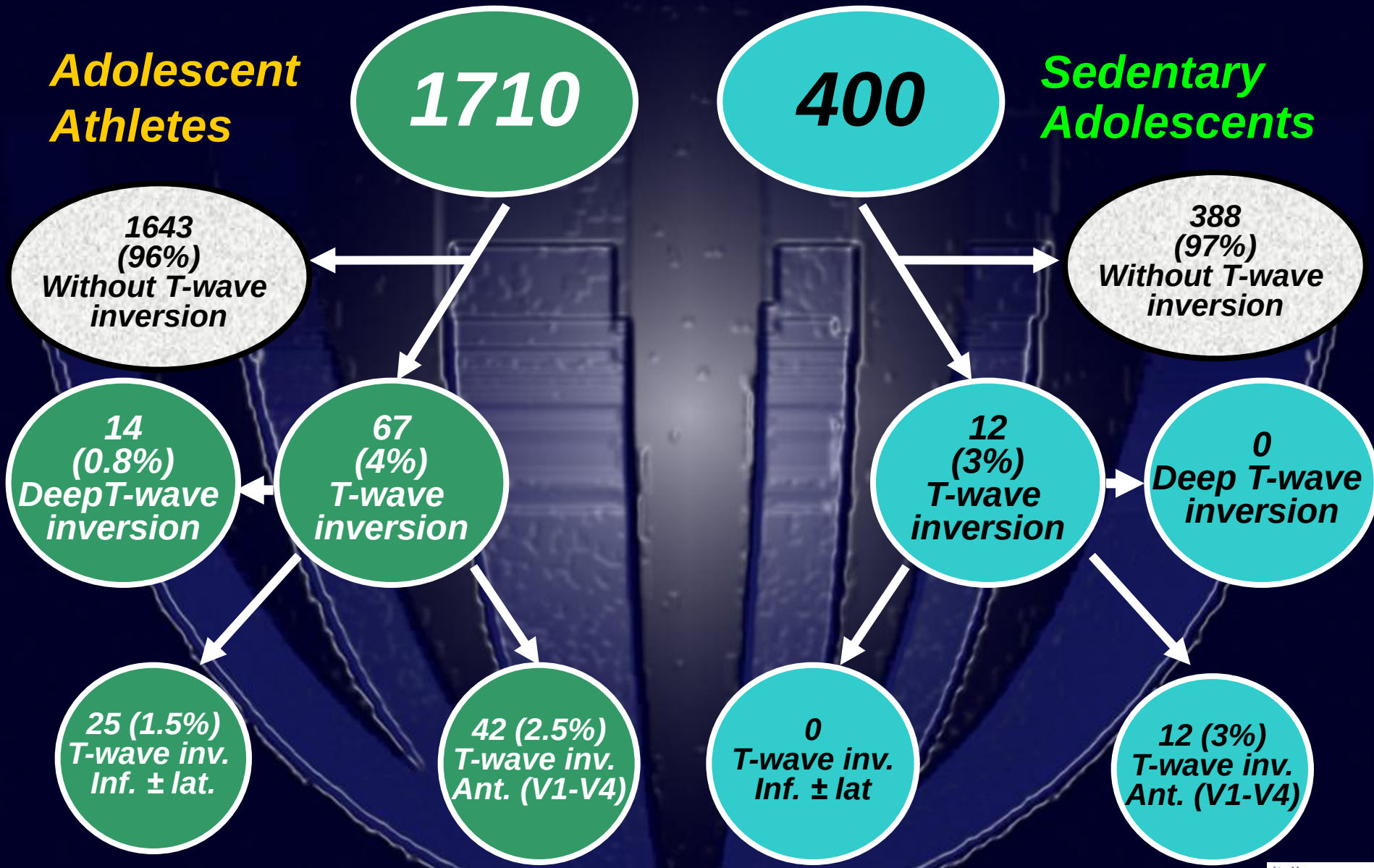
European Heart Journal (2009) **30**, 1728–1735
doi:10.1093/eurheartj/ehp164

CLINICAL RESEARCH
Prevention and epidemiology

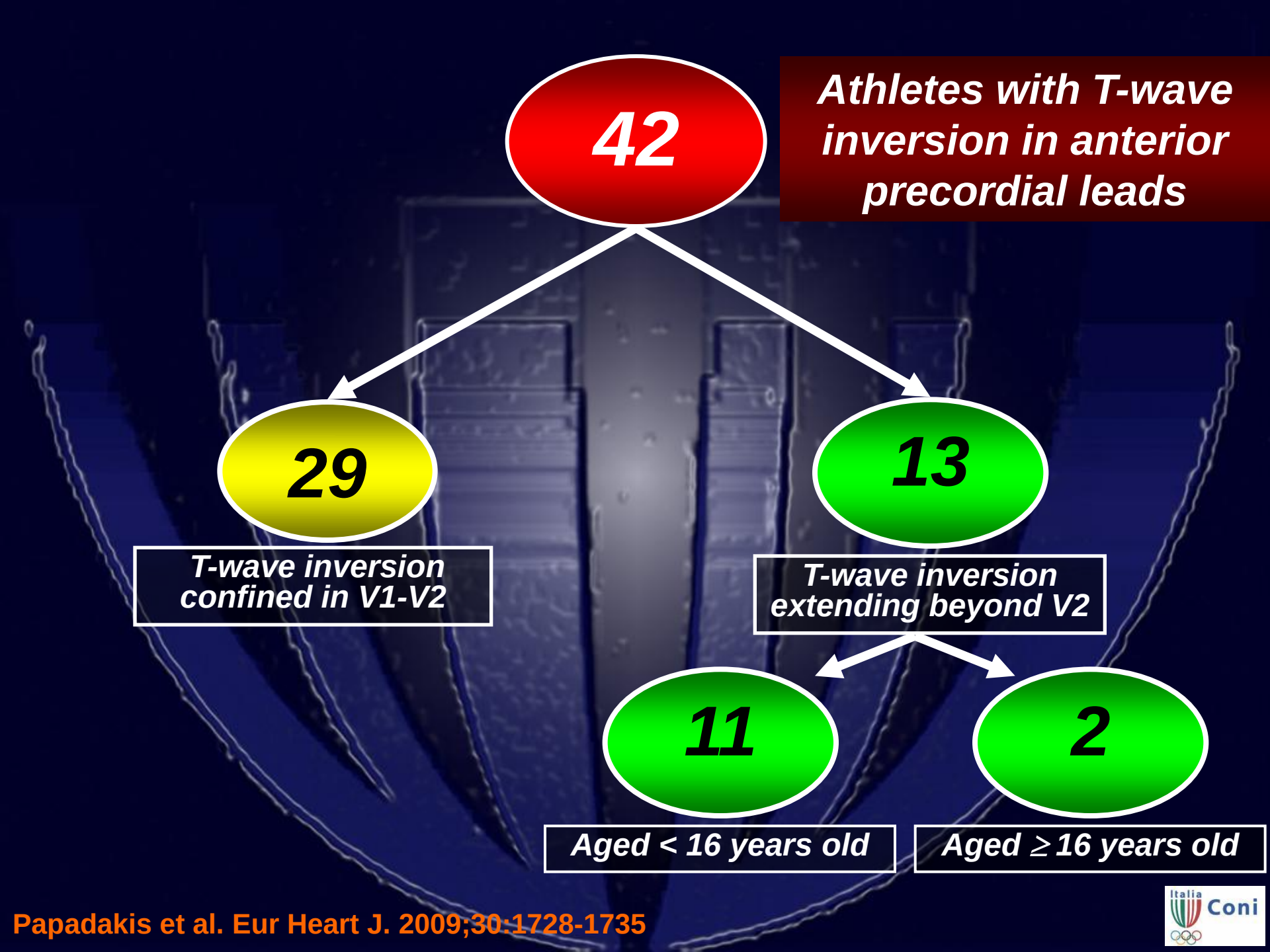
Prevalence and significance of T-wave inversions in predominantly Caucasian adolescent athletes

Michael Papadakis[1,2], Sandeep Basavarajaiah[1,2], John Rawlins[1,2], Carey Edwards[1,2], Jayesh Makan[3], Sami Firoozi[4], Lorna Carby[2], and Sanjay Sharma[1,2]*

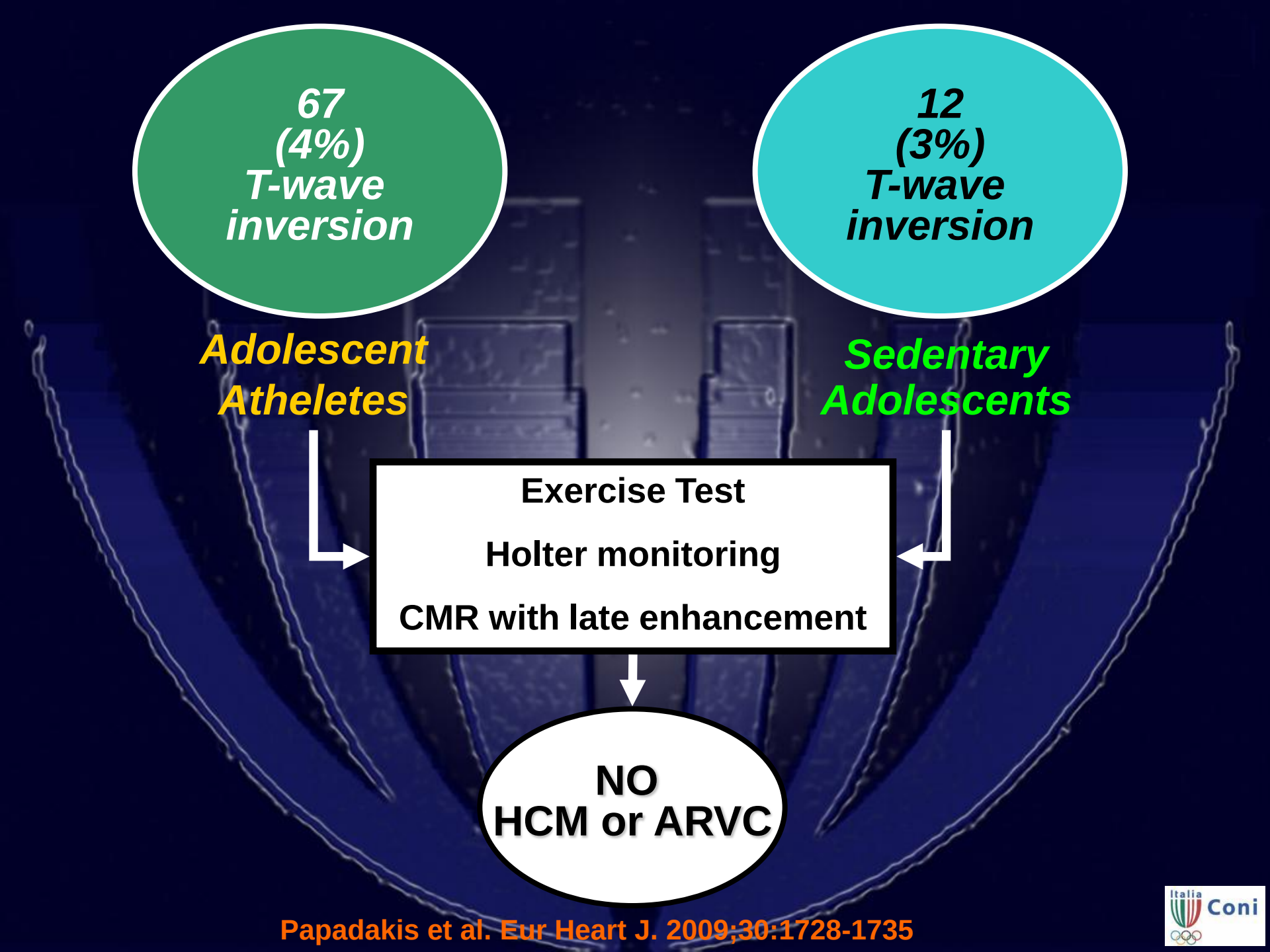
[1]King's College Hospital, Denmark Hill, Denmark Hill, London SE5 9RS, UK; [2]University Hospital Lewisham, Lewisham High Street, London, UK; [3]Harefield Hospital, Hill End Road, London, UK; and [4]St George's Hospital, Blackshaw Road, London, UK



Papadakis et al. Eur Heart J. 2009;30:1728-1735



Papadakis et al. Eur Heart J. 2009;30:1728-1735

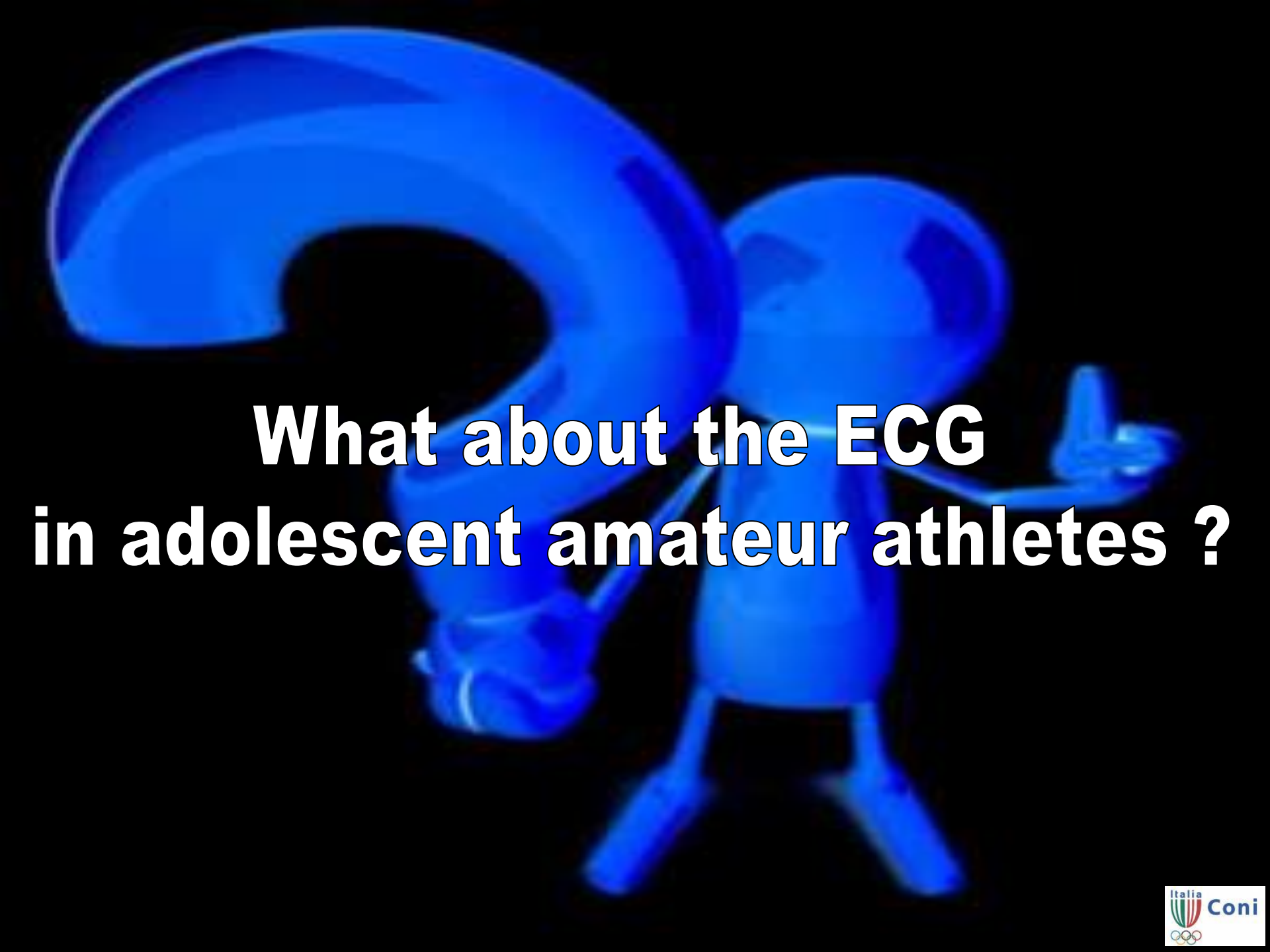


Papadakis et al. Eur Heart J. 2009;30:1728-1735

Repolarization abnormalities in adolescent athletes

- Repolarization abnormalities in anterior precordial leads probably represent ECG juvenile pattern in athletes < 16 years.

- Deep T wave inversion, repolarization abnormalities in inferior and/or lateral leads and repolarization abnormalities beyond V2 in athletes ≥ 16 years require further investigations to exclude cardiomyopathies.


What about the ECG
in adolescent amateur athletes ?



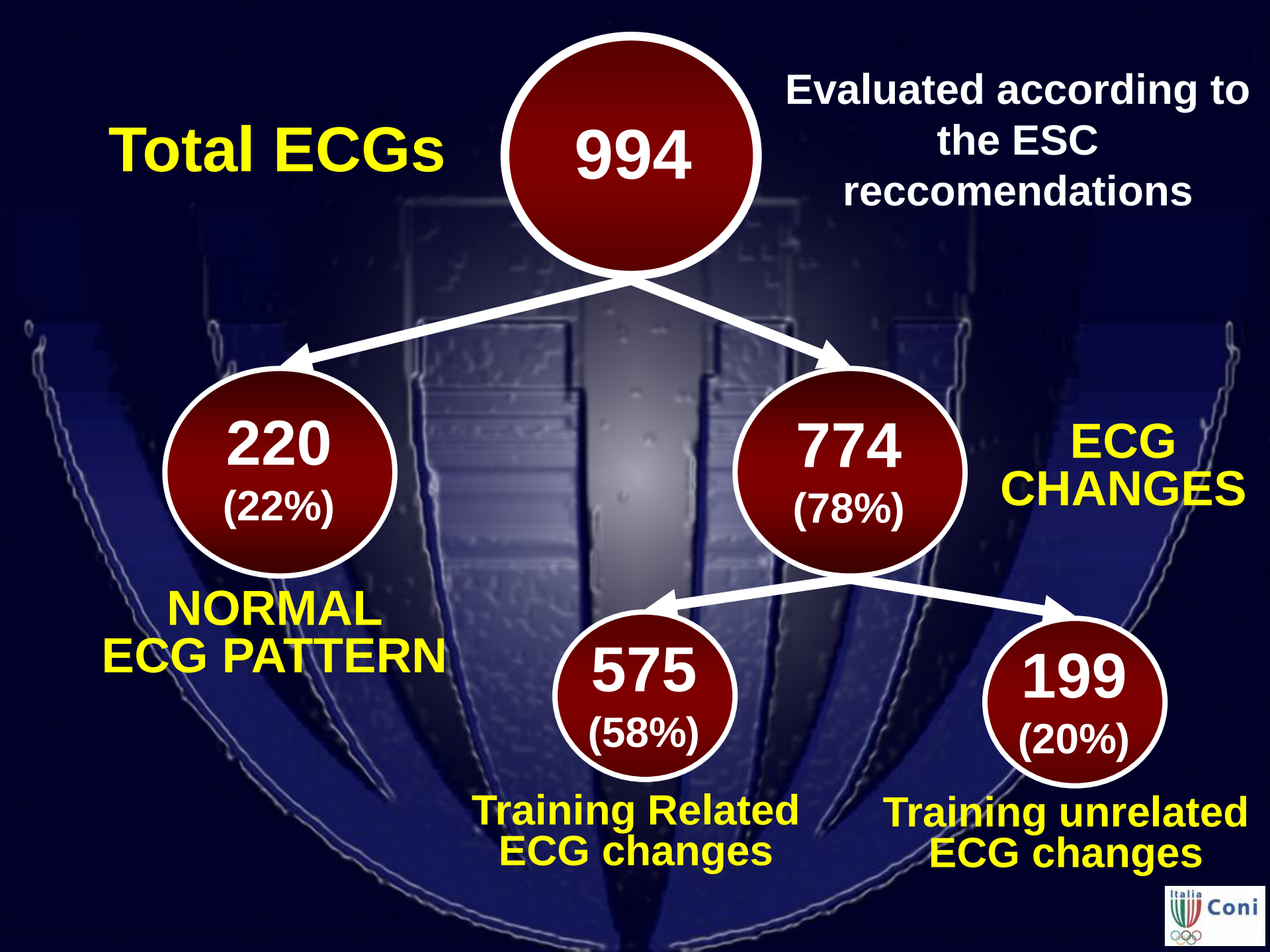





Very few data on adolescents who approach to sport activities!

STUDY POPULATION

Subjects:	**994 adolescent amateur athletes evaluated for competitive sport**
Age:	**14 ± 2 years (median 14; range 12-18)**
Gender:	**784 males (79%), 210 females (21%)**
Training:	**5 ± 1.5 hours/week**
Sports:	**36 different sport disciplines, mostly soccer (37%), fencing (10%), tennis (6%), basketball (5%), track & field (5%), rowing (3%), rugby (3%)**


Total ECGs
994
Evaluated according to the ESC reccomendations
220
(22%)
NORMAL ECG PATTERN
774
(78%)
ECG CHANGES
575
(58%)
Training Related ECG changes
199
(20%)
Training unrelated ECG changes

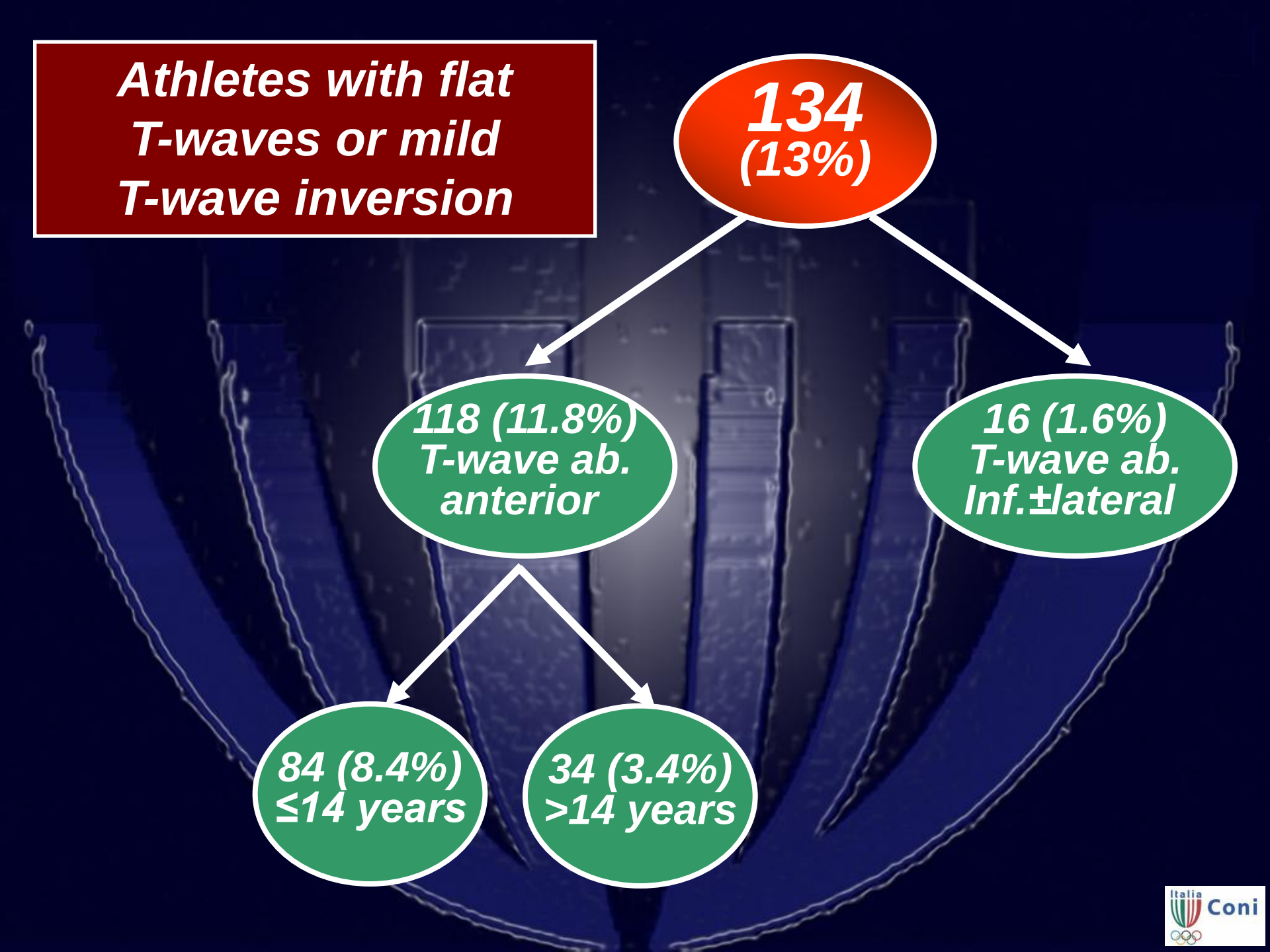
Electrocardiographic findings in 994 adolescent athletes

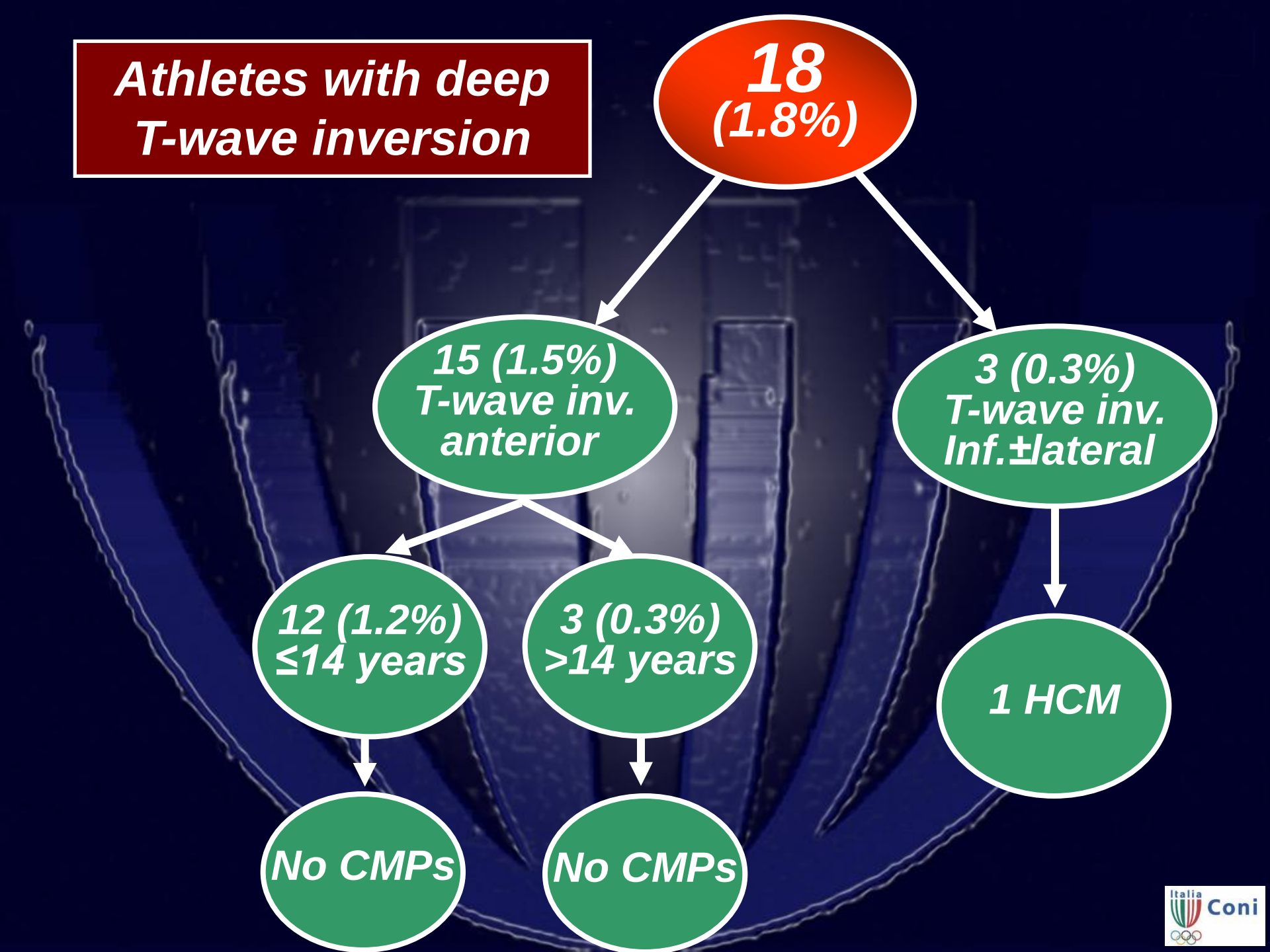
Training related ECG changes

- Sinus bradycardia 21%
- Incomplete RBBB 31%
- Sokolow Lyon (LVH) 17%
- Early repolarization 16%
- 1st degree AV block 1%

Training unrelated ECG changes

- LAD or RAD 2.0%
- LAFH/LPFH 0.1%
- Complete RBBB 0.5%
- LA enlargement 0.5%
- Deep Q wave (≥4 mm) 0.3%
- Brugada Like ECG 0.3%
- Prolonged QTc 1.6%
- Flat/mildly inverted T 13%
- Deep T-wave inv. (≥2 mm) 1.8%


Athletes with flat T-waves or mild T-wave inversion
134 (13%)
118 (11.8%) T-wave ab. anterior
16 (1.6%) T-wave ab. Inf.±lateral
84 (8.4%) ≤14 years
34 (3.4%) >14 years


Athletes with deep T-wave inversion
18 (1.8%)
15 (1.5%) T-wave inv. anterior
3 (0.3%) T-wave inv. Inf.±lateral
12 (1.2%) ≤14 years
3 (0.3%) >14 years
1 HCM
No CMPs
No CMPs

Comparison of electrocardiographic findings in adolescent athletes

Amateur athletes (n=994)		Highly trained athletes (n=1710) Papadakis M et al. Eur Heart J.	
• Sinus bradycardia	21%	• Sinus bradycardia	80%
• Incomplete RBBB	31%	• Incomplete RBBB	30%
• 1st degree AV block	1%	• 1st degree AV block	4.5%
• Sokolow Lyon (LVH)	17%	• Sokolow Lyon (LVH)	45%
• ST segment elevation	16%	• ST segment elevation	45%
• Complete RBBB	0.5%	• Complete RBBB	0.6%
• Flat/mild inv. T-waves	13%	• T-wave inversion	4%
• Deep T-wave inversion	1.8%	• Deep T-wave inversion	0.8%

CONCLUSIONS

- 12-lead ECG must be included in the pre-participation screening of adolescent athletes to prevent SCD.
- Specific age criteria should be included in the recommendations for the interpretation of repolarization abnormalities in anterior precordial leads in adolescent athletes.
- Further studies are needed to evaluate the clinical outcome of repolarization abnormalities in adolescent athletes.








Thank you for your attention !