Skríning a rizika náhlé srdeční smrti u dětí a mladistvých – mýtus nebo realita

Janoušek J., Kubuš P.

Dětské kardiocentrum 2. LF UK v Praze a FN v Motole, Praha

Náhlá srdeční smrt (NSS) u dospívajících a mladých dospělých

Table 1 Incidence of sudden cardiac death/arrest in young people and athletes according to different reporting systems

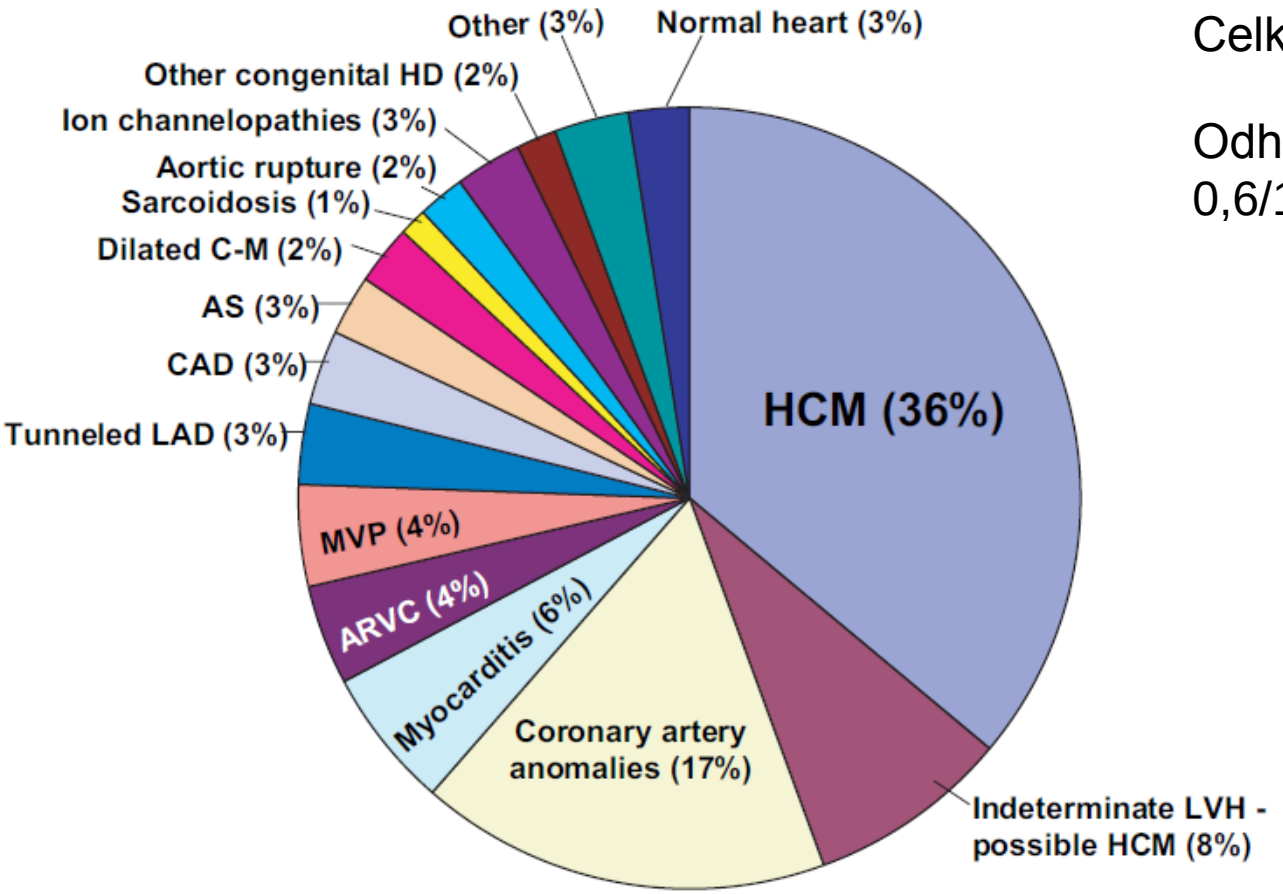
Study population	Ref.	Study design and reporting system	Incidence (person-years)
US Military (age 18–35)	Eckart *et al.*[21]	Retrospective, mandatory	1:9000
Italian Athletes (age 12–35)	Corrado *et al.*[10]	Prospective, mandatory	1:25,000
US Adolescents (age 12–19)	Atkins *et al.*[20]	Prospective, EMS	1:27,000
US Children (age 10–14)	Chugh *et al.*[22]	Prospective, EMS/ Hospitals	1:58,000
US Athletes (age 12–35)	Maron *et al.*[19]	Retrospective, public media reports	1:160,000

EMS, emergency medical service.

Corrado D et al. EHJ 2011

Diagnózy (studie USA)

N = 1049 výkonnostních sportovců (< 35 let) s kardiální etiologií náhlé smrti



Celkem náhlých úmrtí: 1866

Odhadovaná incidence NSS: 0,6/100.000 osobo-roků

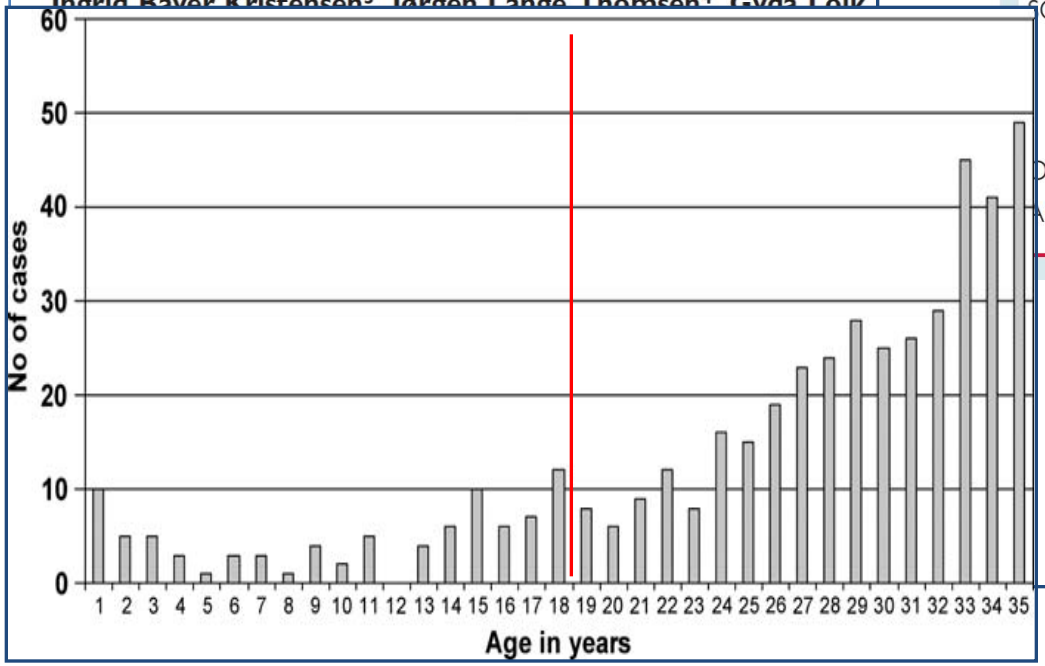
Distribution of cardiovascular causes of sudden death in 1435 young competitive athletes. Minneapolis Heart Institute Foundation Registry, 1980 to 2005.

Incidence NSS (populační studie)

European Heart Journal (2011) **32**, 983–990
doi:10.1093/eurheartj/ehq428

Nationwide study of sudden cardiac
persons aged 1–35 years

Bo Gregers Winkel[1,2]*, Anders Gaarsdal Holst[1,2], Juliane Theil
Ingrid Bayer Kristensen[3], Jørgen Lange Thomsen[4], Gyda Lolk



Dánsko, 2000-2006

Table 4 Incidence rates for sudden cardiac death in persons aged 1–35 years

Annual incidence rates of SCD (per 100 000)	Total	Male	Female
1–35 years old (population 2.38 million)			
SCD, including non-autopsied cases	2.8	3.7	1.9
Autopsied SCD	1.9	2.5	1.3
of which unexplained after autopsy (SUD)	0.8	1.0	0.7
Out-of-hospital SCD	2.6		
Autopsied, witnessed SCD	0.9		

Dánsko: 5,38 mil. obyvatel
Populace 1 – 35 let: 2,38 mil.

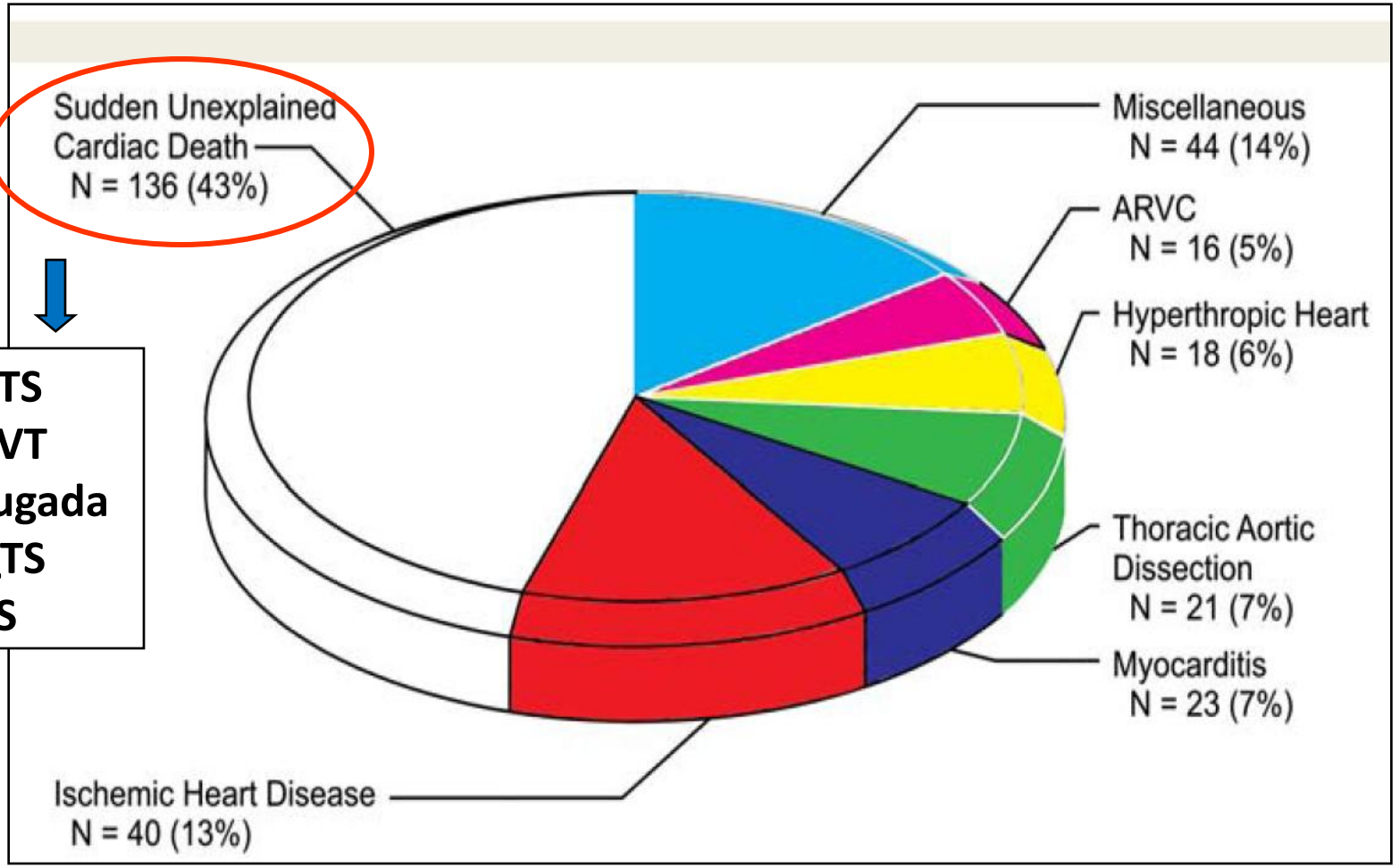
Projekce pro ČR: ~95 – 140 úmrtí/rok

European Heart Journal (2011) **32**, 983–990
doi:10.1093/eurheartj/ehq428

CLINICAL RESEARCH
Arrhythmia/electrophysiology

Nationwide study of sudden cardiac death in persons aged 1–35 years

Bo Gregers Winkel[1,2]*, Anders Gaarsdal Holst[1,2], Juliane Theilade[1,2], Ingrid Bayer Kristensen[3], Jørgen Lange Thomsen[4], Gyda Lolk Ottesen[5], Henning Bundgaard[2], Jesper Hastrup Svendsen[1,2,6], Stig Haunsø[1,2,6], and Jacob Tfelt-Hansen[1,2]



- **LQTS**
- **CPVT**
- **Brugada**
- **SQTS**
- **ERS**

Náhlá srdeční smrt je u dětí a mladistvých z větší části způsobena dědičnými onemocněními

- Cíle:
  - zabránit opakování NSS u příbuzných
  - uvažovat o formě screeningu onemocnění
    - rizikové skupiny?
      - sportovci??

Incidence náhlé srdeční smrti ve věku 1-18 let

European Heart Journal Advance Access published December 15,

European Heart Journal
doi:10.1093/eurheartj/eht509

CLINIC

Preven

Sudden cardiac death in children (1–18 y

Table 2 Demographics of the sudden cardiac deaths, 1–18 years 2000–06, Denmark

SCD of total sudden unexpected deaths	87/114	76%	5.8% of all deaths
Male SCD	58/87	67%	
Witnessed SCD	45/87	52%	
Median age	13 years	range 1–18	
	n	**%**	
Activity at death			
Sleep	28	32	
Home, relaxed	32	37	
Public place, relaxed	5	6	
High intensity sport	4	5	
Moderate intensity activity	8	9	
Unknown	10	11	

Table 4 Cause of death, autopsied sudden unexpected death cases (*n* = 88), 1–18 years, Denmark 2000–06

Cause of death, autopsied sudden unexpected death cases (*n* = 88)	*n*	Potentially inherited cardiac disease
Rejection of transplanted heart	1	
LQTS	1	x
Total cardiac disease	62 (70%)	43 (49%)

Comparison of the Frequency of Sudden Cardiovascular Deaths in Young Competitive Athletes Versus Nonathletes: Should We Really Screen Only Athletes?

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

Am J Cardiol 2016

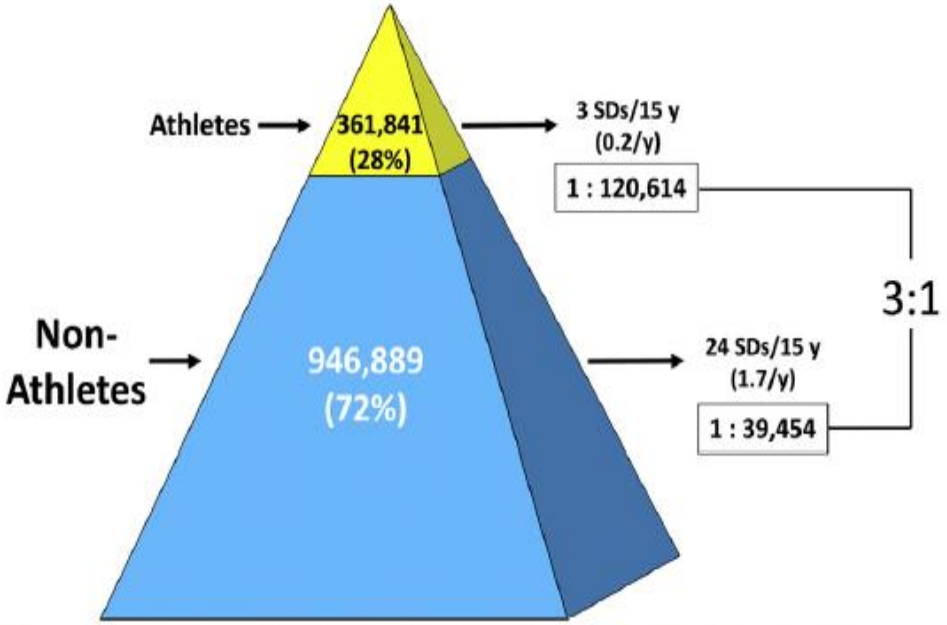


Figure 1. Incidence of sudden death in high school and college students comparing competitive athletes and nonathletes, 2000 to 2014, in Hennepin County, Minnesota. Nonathletes greatly exceed athletes in person-years and the number of SDs due to genetic and/or congenital heart disease (i.e., 3:1). SDs = sudden deaths; y = year.

Epidemiology and Outcomes From Out-of-Hospital Cardiac Arrest in Children

The Resuscitation Outcomes Consortium Epistry–Cardiac Arrest

Dianne L. Atkins, MD; Siobhan Everson-Stewart, MS; Gena K. Sears, BSN;
Mohamud Daya, MD, MS; Martin H. Osmond, MD, CM, FRCPC;
Craig R. Warden, MD, MPH; Robert A. Berg, MD;
the Resuscitation Outcomes Consortium Investigators

Table 1. Patient Characteristics

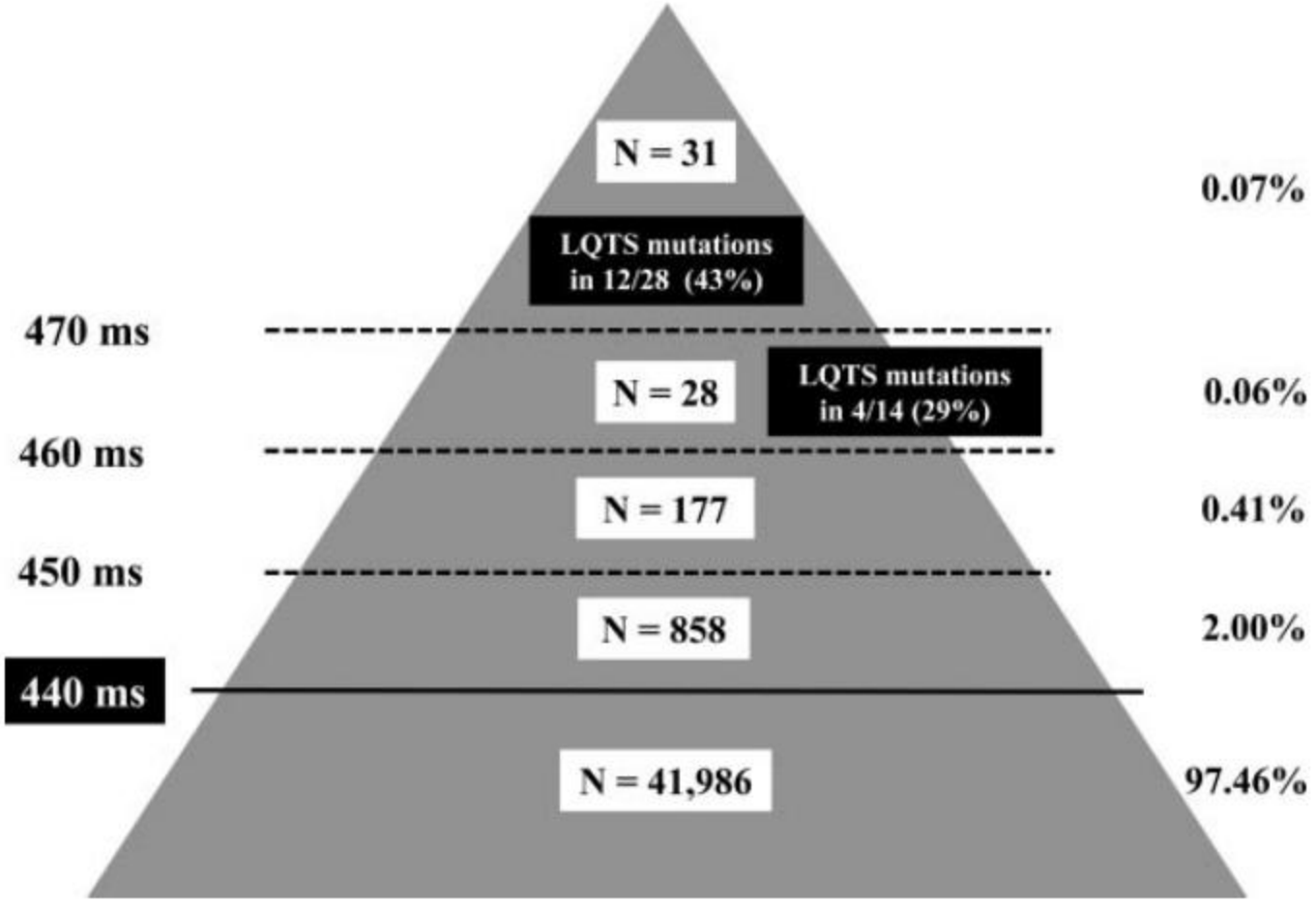
Characteristic	Infants (n=277)	Children (n=154)	Adolescents (n=193)
Age, mean (SD), y	0.3 (0.2)	4.2 (3.0)	16.4 (2.1)
Age, median (Q1, Q3), y	0.2 (0.1, 0.4)	3.0 (1.6, 7.0)	17.0 (15.0, 18.0)
Male, n (%)*	160 (59)	92 (60)	134 (69)
Incidence/100 000 person-y (95% CI)	72.71 (62.02–83.39)	3.73 (3.02–4.43)	6.37 (5.30–7.44)
EMS treated, n (%)	232 (84)	135 (88)	136 (70)
No EMS treatment, n (%)	45 (16)	19 (12)	57 (30)

*Percentage is of those known.

Circulation. 2009;119:1484-1491

Prevalence of the Congenital Long-QT Syndrome

Peter J. Schwartz, MD*; Marco Stramba-Badiale, MD, PhD*; Lia Crotti, MD, PhD; Matteo Pedrazzini, PhD; Alessandra Besana, PhD; Giuliano Bosi, MD; Fulvio Gabbarini, MD; Karine Goulene, MD, PhD; Roberto Insolia, PhD; Savina Mannarino, MD; Fabio Mosca, MD; Luigi Nespoli, MD; Alessandro Rimini, MD; Enrico Rosati, MD; Patrizia Salice, MD; Carla Spazzolini, DVM, MS



Předpoklady efektivního screeningu

Screening for Sudden Cardiac Death in the Young : Report From a National Heart, Lung, and Blood Institute Working Group

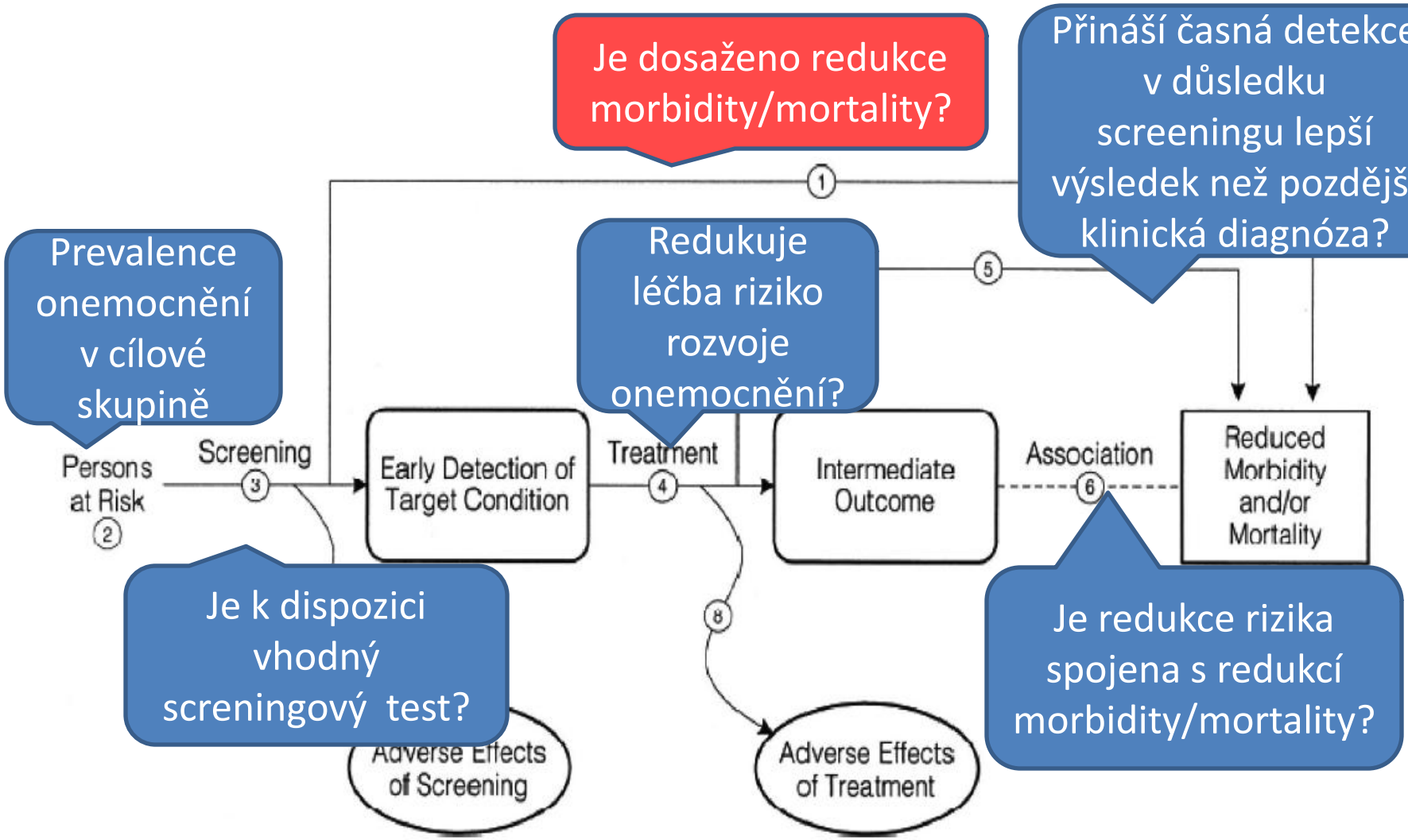


Figure. US Preventive Services Task Force's analytic framework for screening.

Kaltman JR et al. Circulation 2011

Preparticipační screening
(Návrhy) doporučení

European Society of Cardiology Proposal for a common European protocol	**American Heart Association** Recommendations and Considerations
WG of Cardiac Rehabilitation and Exercise Physiology WG of Myocardial and Pericardial Diseases	Council on Nutrition, Physical Activity, and Metabolism
History	History
Physical examination	Physical examination
12-lead resting ECG (specifed protocol)	----

Corrado D et al. EHJ 2005
Maron BJ et al. Circulation 2007

Interpretace EKG u sportovců

Praktické výstupy

Electrocardiographic interpretation in athletes: the 'Seattle Criteria'

Jonathan A Drezner,[1] Michael John Ackerman,[2] Jeffrey Anderson,
Chad A Asplund,[5] Aaron L Baggish,[6] Mats Börjesson,[7] Bryan C C
Domenico Corrado,[9] John P DiFiori,[10] Peter Fischbach,[11] Victor Fr
Kimberly G Harmon,[1] Hein Heidbuchel,[12] Joseph Marek,[13] David
Stephen Paul,[15] Antonio Pelliccia,[16] Jordan M Prutkin,[14] Jack C S
Christian M
Mathew G V

criteria
ation in

Full text

The Seattle Criteria increase the specificity of preparticipation ECG screening among elite athletes

Br J Sports Med 2014;**48**:15 1144-1150 Published Online

	% podezřelých EKG
ESC (2010)	17,3
Seattle kritéria	4,5

Skutečná kardiologická abnormalita: 0,3 %

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 69, NO. 8, 2017

ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2017.01.015

CURRENT OPINION

Pro věk: (12) 16 – 30 (>30) let

FIGURE 1 International Consensus Standards for Electrocardiographic Interpretation

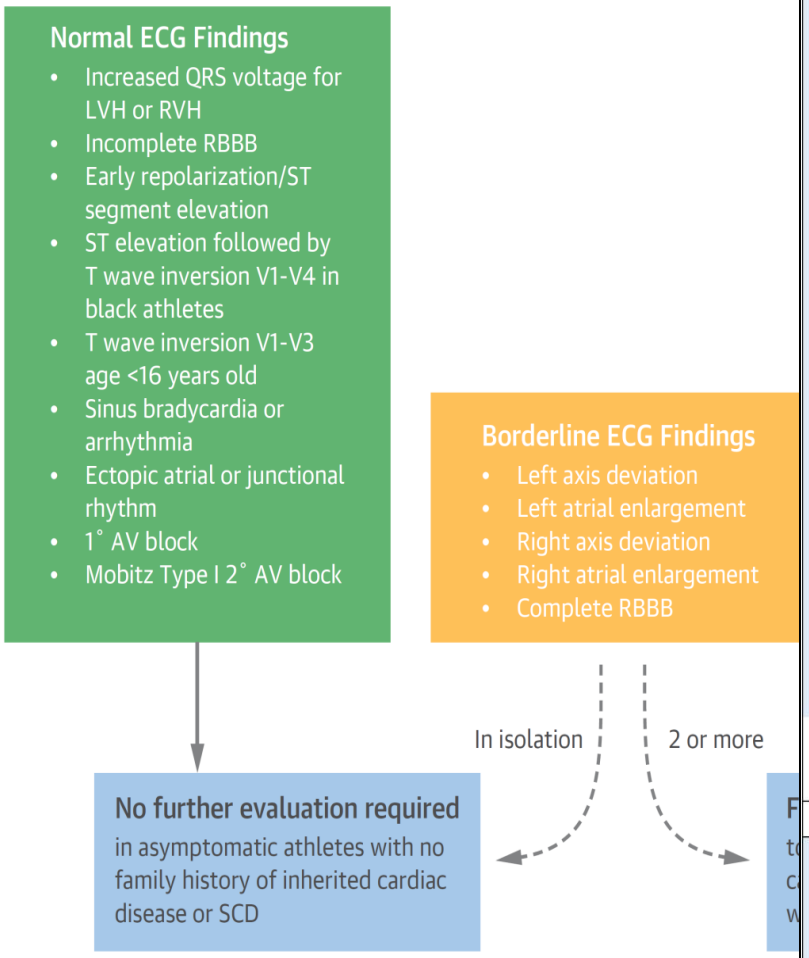


TABLE 1 International Consensus Standards for Electrocardiographic Interpretation in Athletes: Definitions of ECG Criteria

Abnormal ECG findings in athletes

These ECG findings are unrelated to regular training or expected physiologic adaptation to exercise, may suggest the presence of pathologic cardiovascular disease, and require further diagnostic investigation.

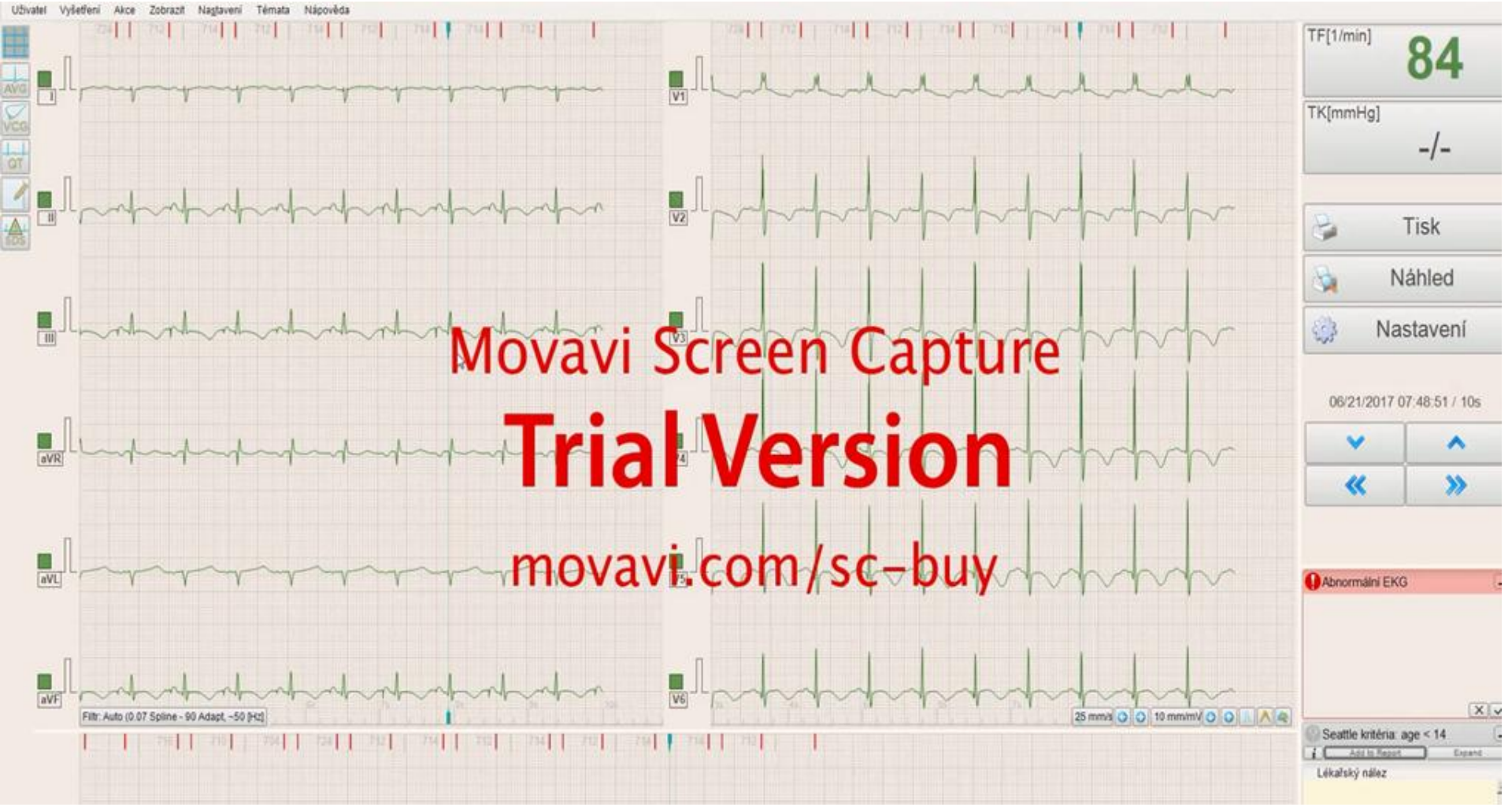
ECG abnormality	Definition
T wave inversion	≥1 mm in depth in two or more contiguous leads; excludes leads aVR, III, and V_1
• Anterior	• V_2-V_4 – excludes: black athletes with J-point elevation and convex ST-segment elevation followed by TWI in V_2-V_4; athletes age <16 with TWI in V_1-V_3; and biphasic T waves in only V_3
• Lateral	• I and AVL, V_5 and/or V_6 (only one lead of TWI required in V_5 or V_6)
• Inferolateral	• II and aVF, V_5-V_6, I and AVL
• Inferior	• II and aVF
ST-segment depression	≥0.5 mm in depth in two or more contiguous leads
Pathologic Q waves	Q/R ratio ≥0.25 or ≥40 ms in duration in two or more leads (excluding III and aVR)
Complete left bundle branch block	QRS ≥120 ms, predominantly negative QRS complex in lead V_1 (QS or rS), and upright notched or slurred R wave in leads I and V_6
Profound nonspecific intra-ventricular conduction delay	Any QRS duration ≥140 ms
Epsilon wave	Distinct low amplitude signal (small positive deflection or notch) between the end of the QRS complex and onset of the T-wave in leads V_1-V_3
Ventricular pre-excitation	PR interval <120 ms with a delta wave (slurred upstroke in the QRS complex) and wide QRS (≥120 ms)
Prolonged QT interval*	QTc ≥470 ms (male)
	QTc ≥480 ms (female)
	QTc ≥500 ms (marked QT prolongation)
Brugada Type 1 pattern	Coved pattern: initial ST-segment elevation ≥2 mm (high take-off) with downsloping ST-segment elevation followed by a negative symmetric T-wave in ≥ 1 leads in V_1-V_3
Profound sinus bradycardia	<30 beats/min or sinus pauses ≥3 s
Profound 1° AV block	≥400 ms
Mobitz Type II 2° AV block	Intermittently non-conducted P waves with a fixed PR interval
3° AV block	Complete heart block
Atrial tachyarrhythmias	Supraventricular tachycardia, atrial fibrillation, atrial flutter
PVC	≥2 PVCs per 10 s tracing
Ventricular arrhythmias	Couplets, triplets, and non-sustained ventricular tachycardia

Borderline ECG findings in athletes

These ECG findings in isolation likely do not represent pathologic cardiovascular disease in athletes, but the presence of two or more borderline findings may warrant additional investigation until further data become available.

ECG abnormality	Definition
Left axis deviation	−30° to −90°
Left atrial enlargement	Prolonged P wave duration of >120 ms in leads I or II with negative portion of the P-wave ≥1 mm in depth and ≥40 ms in duration in lead V_1
Right axis deviation	>120°
Right atrial enlargement	P-wave ≥2.5 mm in II, III, or aVF
Complete right bundle branch block	rSR′ pattern in lead V1 and a S wave wider than R wave in lead V_6 with QRS duration ≥120 ms

Semi-automatická analýza EKG kritérií (BTL CardioPoint 2.23, Med. Technologies CZ, a.s.) *Projekt TAČR TA 02011258: Náhlá srdeční smrt u dětí a mladistvých*



Míra nesouhlasného hodnocení
EKG je významná
přes jasně specifikovaná kritéria

Europace (2015) **17**, 1435–1440
doi:10.1093/europace/euu385

CLINICAL RESEARCH
Electrocardiology and risk stratificatio

Variability in interpretation of the electrocardiogram in young athletes: an unrecognized obstacle for electrocardiogram-based screening protocols

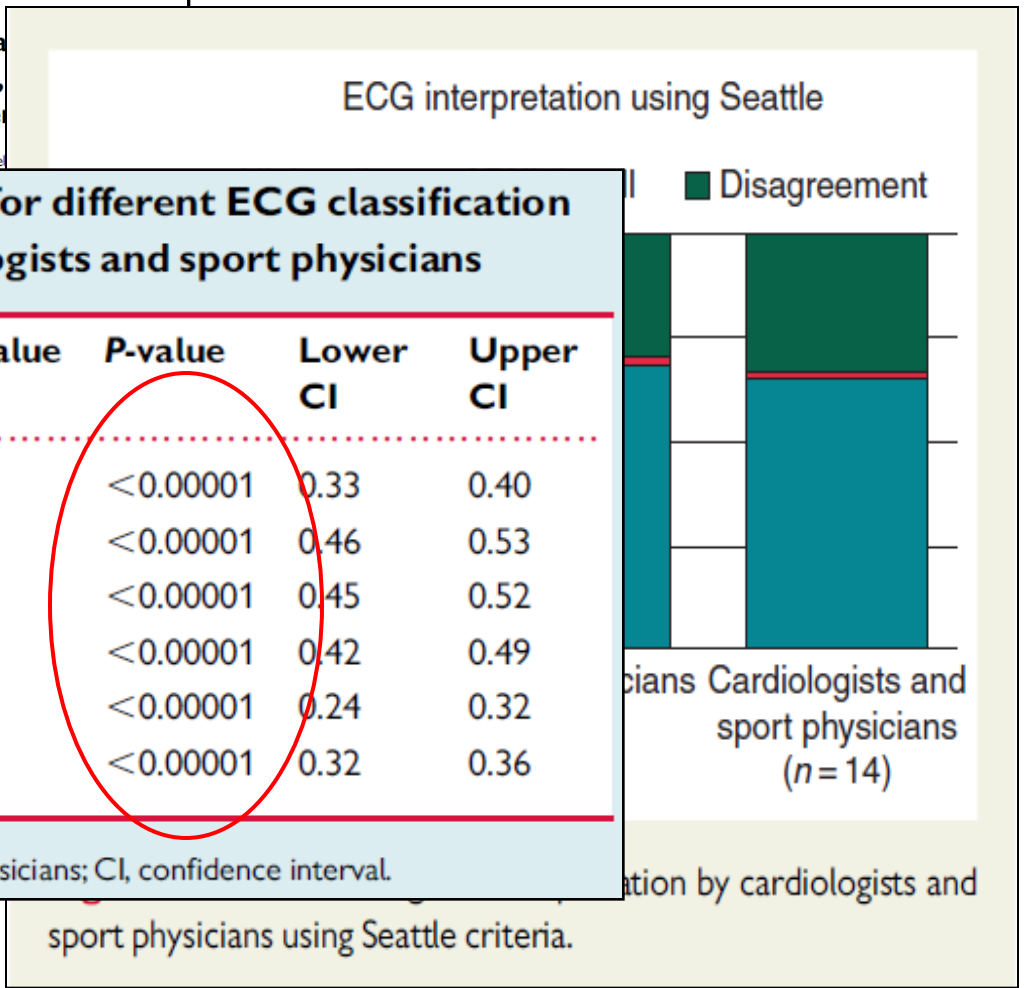
**Benjamin Berte[1], Mattias Duytschaever[1,2], Juliana Elices[1†], Vikas Kata
Liesbeth Timmers[2], Frédéric Van Heuverswyn[2], Roland Stroobandt[2],
Karel Watteyne[3], Elke Vandensteen[3], Yves Vandekerckhove[1], and Re**

[1]Department of Cardiology, Sint-Jan Hospital Bruges, Ruddershove 10, 8000 Bruges, Belgium; [2]Heart Center, Ghent University Hospital, Ghent, Be
Rehabilitation and Sports Medicine, Sint-Jan Hospital Bruges, Br

Table 4 Kappa values for different ECG classification criteria among cardiologists and sport physicians

	Kappa-value	P-value	Lower CI	Upper CI
Corrado CA	0.37	<0.00001	0.33	0.40
Uberoi CA	0.50	<0.00001	0.46	0.53
Marek CA	0.49	<0.00001	0.45	0.52
Seattle CA	0.45	<0.00001	0.42	0.49
Seattle SP	0.28	<0.00001	0.24	0.32
Seattle CA + SP	0.34	<0.00001	0.32	0.36

CA, cardiologists; Sport, sport physicians; CI, confidence interval.



Europace (2017) **19**, 139–163
doi:10.1093/europace/euw243

EHRA POSITION PAPER

Pre-participation cardiovascular evaluation for athletic participants to prevent sudden death: Position paper from the EHRA and the EACPR, branches of the ESC. Endorsed by APHRS, HRS, and SOLAECE

However, the scope of the PPE is not merely limited to prevention of SCD, but extends to the identification and appropriate management of those CV conditions that may worsen because of intensive athletic training, as well as PPE may be the time for primary prevention of CV disease and improvement of CV health

Protocol of the preparticipation evaluation

The protocol of PPE including clinical history, physical examination, and 12-lead ECG demonstrates to have superior diagnostic capability than just clinical history and physical examination

Europace (2017) **19**, 139–163
doi:10.1093/europace/euw243

EHRA POSITION PAPER

Pre-participation cardiovascular evaluation for athletic participants to prevent sudden death: Position paper from the EHRA and the EACPR, branches of the ESC. Endorsed by APHRS, HRS, and SOLAECE

Available data suggests that routine echocardiography or other imaging modalities do not add substantial diagnostic power to the PPE as a mass screening technique and do not appear to be cost/effective.

It goes far beyond the scope of the document to suggest global national PPE programmes.

388

VYHLÁŠKA

ze dne 28. listopadu 2013,

kterou se mění vyhláška č. 388/2011 Sb., o provedení některých ustanovení zákona o poskytování dávek osobám se zdravotním postižením, ve znění pozdějších předpisů

(3) Vstupní lékařská prohlídka vedle základního vyšetření obsahuje,

a) jde-li o výkonnostního sportovce nebo uchazeče ke vzdělávání ve sportovní škole,

1. zjištění základní antropometrie,

2. standardní klidové elektrokardiografické vyšetření

(2) Pro účely této vyhlášky se rozumí

a) výkonnostním sportovcem osoba, která

1. vykonává výkonnostní sport v organizovaných sportovních soutěžích nebo se na ně připravuje a

2. je registrována v organizaci, která zajišťuje přípravu výkonnostních sportovců, popřípadě organizuje sportovní soutěže,

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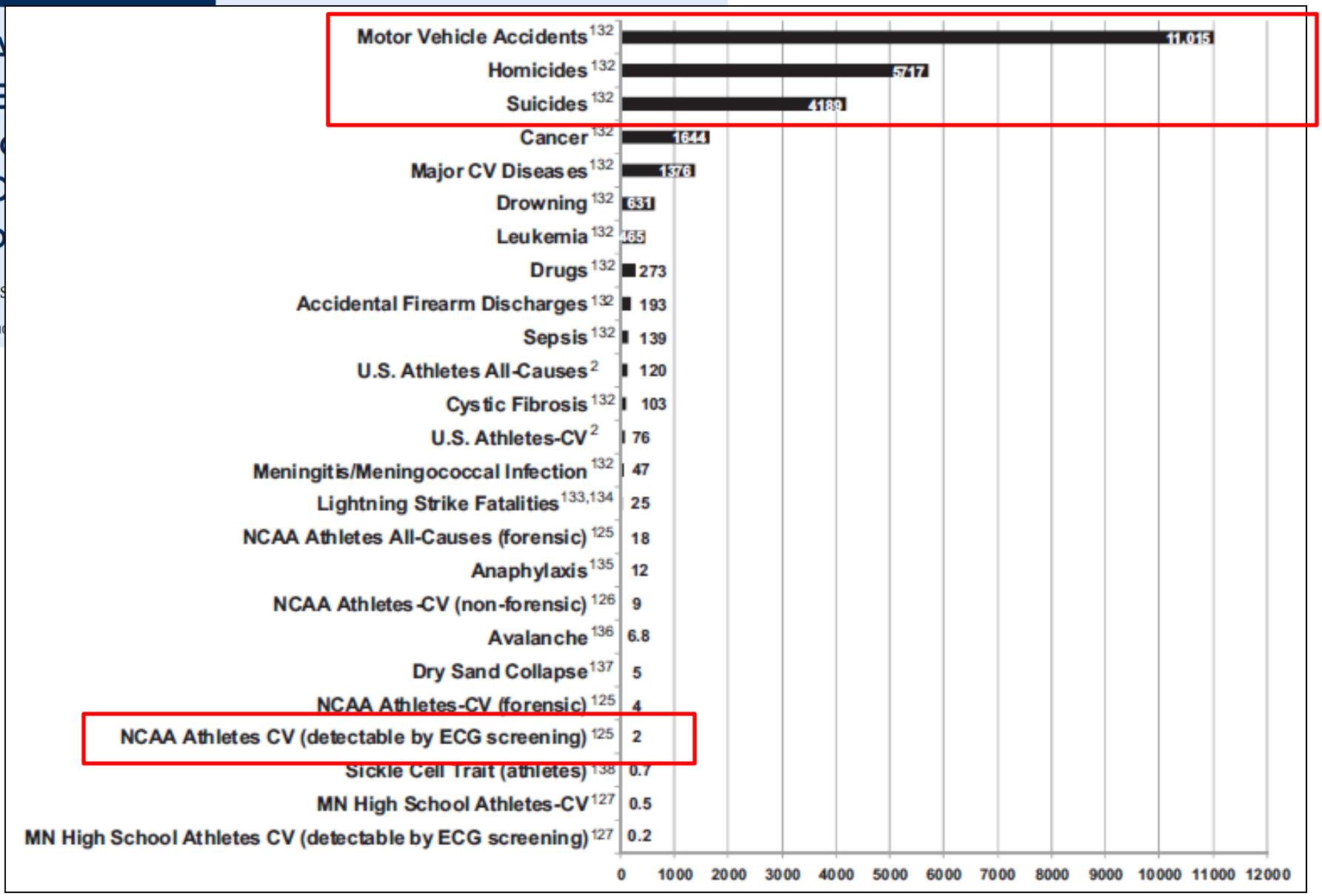
http://dx.doi.org/10.1016/j.jacc.2014.05.006

Maron BJ et al.

SCIENTIFIC STATEMENT



Journal of Pediatric Cardiology and Cardiac Surgery 1(1): 45–48 (2017)

Review

〈Clinical Science: Sudden Cardiac Death〉

JSPCCS
特定非営利活動法人
日本小児循環器学会
Japanese Society of Pediatric Cardiology and Cardiac Surgery

Screening for Sudden Cardiac Death in Children: Useful Tool or Wishful Thinking?

Jan Janoušek, MD, PhD and Peter Kubuš, MD, PhD

- Dostupné studie nedokládají jednoznačně pozitivní efekt plošného EKG screeningu na snížení výskytu náhlé srdeční smrti u dětí a mladistvých
- Jiné, potenciálně efektivnější, strategie soutěžící o zdroje
  - rodinný screening u probandů s NSS/ maligními arytmiemi
  - AED

Závěr

- Skrínink v principu vede k vyššímu záchytu patologií
- Hlavním problémem (kromě vyjasnění cost/benefit) jsou falešně pozitivní nálezy a celkově variabilní interpretace EKG
- Praktická aplikace předpokládá dostatečné proškolení nemalého počtu hodnotitelů
- Absolutní riziko náhlé smrti u dětí je nízké

Úkoly do budoucna

- Trénink hodnotitelů v interpretaci EKG
- Férová komunikace se subjekty ohledně rizik falešně pozitivních nálezů
- Určení velkosti populace podstupující skríning
- Kontrolované studie na dobře definovaných populacích


HLEDÁTE JEHLU V KUPCE SENA?
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