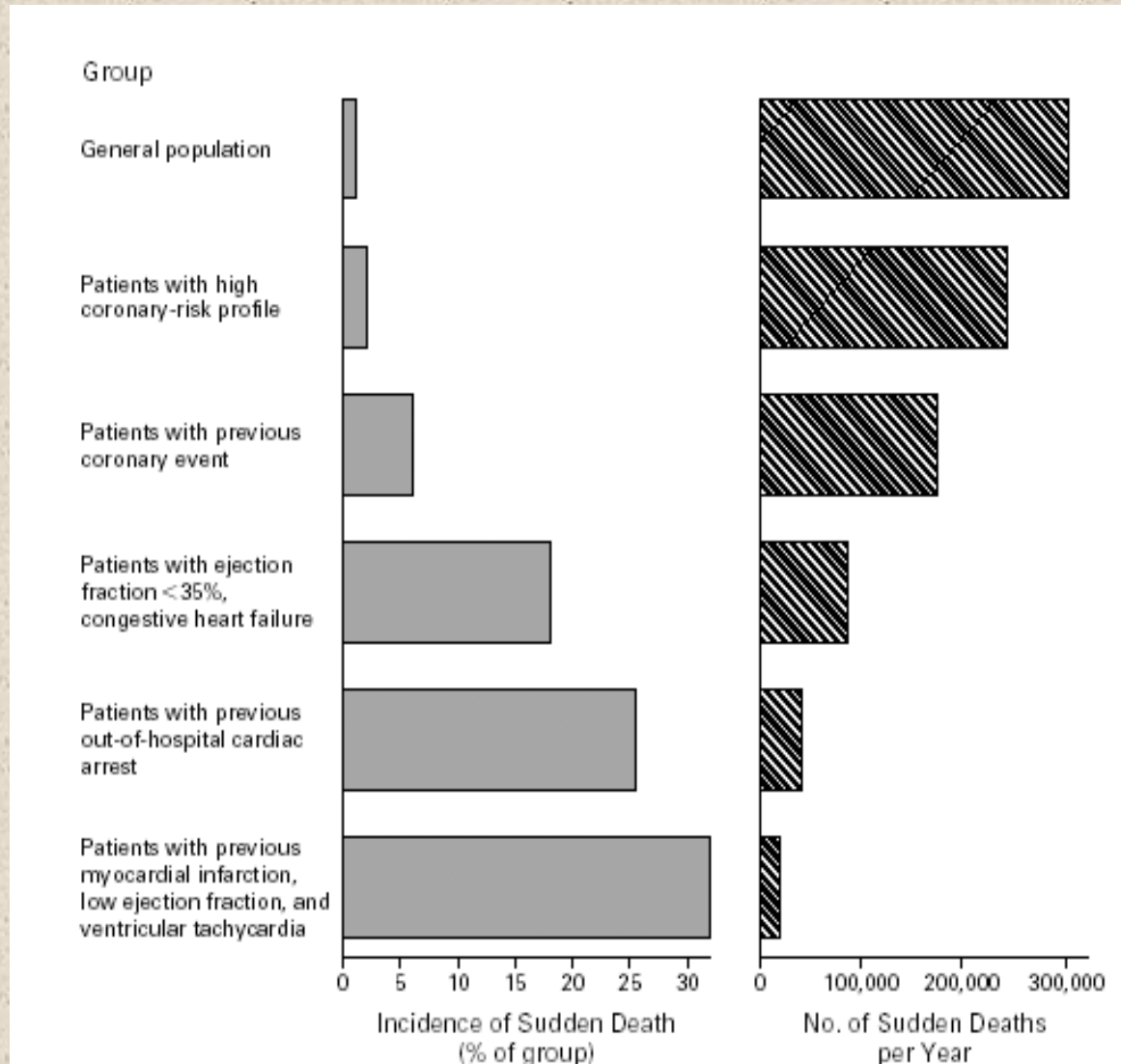




# Epidemiology of sudden death

**Prof. Dr. Martin Borggrefe**  
Mannheim

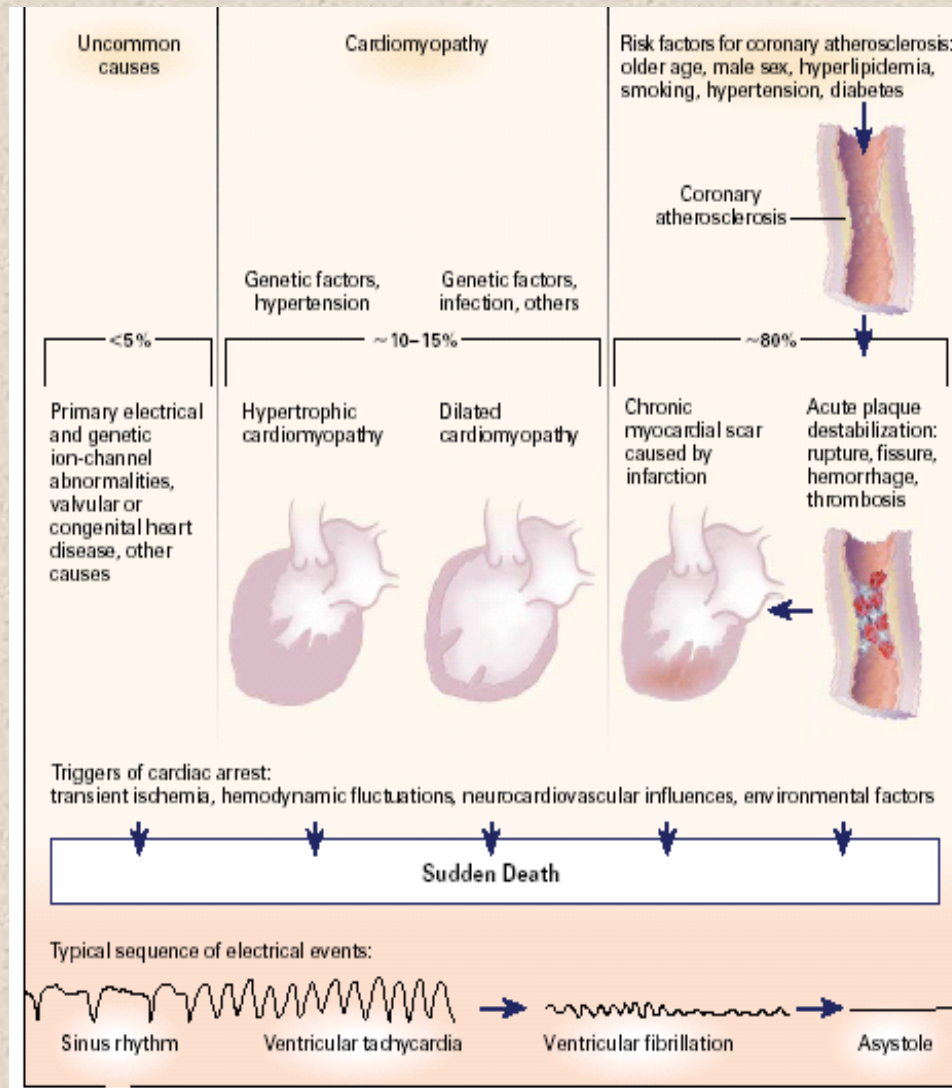
# The incidence of SCD in specific populations



Huikuri et al, N Engl J Med, 2001; 345:1473-1482



# Pathophysiology and Epidemiology of SCD



Huikuri et al, N Engl J Med, 2001; 345:1473-1482



# Public Health Burden of Sudden Cardiac Death in the United States

Eric C. Stecker, MD, MPH; Kyndaron Reinier, PhD; Eloi Marijon, MD;  
Kumar Narayanan, MD; Carmen Teodorescu, MD, PhD; Audrey Uy-Evanado, MD;  
Karen Gunson, MD; Jonathan Jui, MD, MPH; Sumeet S. Chugh, MD

**Circ Arrhythm Electrophysiol. 2014;7:212-217**

# Sudden Cardiac Death Burden

## Female Mortality for Sudden Cardiac Death, Common Diseases, and Individual Cancers

Disease	No. of Deaths	Death Rate
<b>Overall heart disease</b>	<b>293.187</b>	<b>188</b>
<b>Sudden cardiac death</b>	<b>69.524 (58.152-82.294)</b>	<b>45 (37-53)</b>
<b>Overall cancer</b>	<b>270.865</b>	<b>174</b>
Lung cancer	70.040	45
Breast cancer	40.576	26
Colorectal cancer	25.918	17
<b>Cerebrovascular disease</b>	<b>76.769</b>	<b>49</b>
<b>Chronic lower respiratory disease</b>	<b>72.234</b>	<b>46</b>
<b>Alzheimer disease</b>	<b>54.916</b>	<b>35</b>
<b>Accidents</b>	<b>42.999</b>	<b>28</b>



# Sudden Cardiac Death Burden

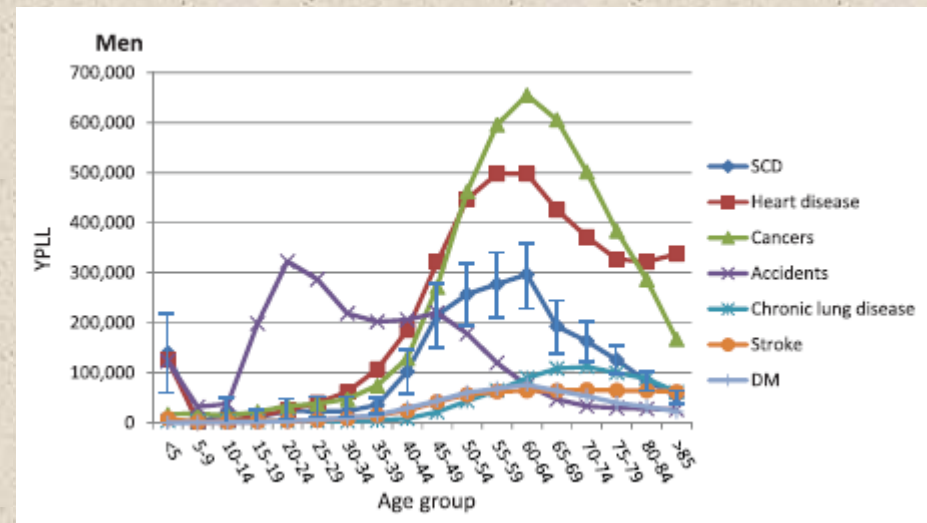
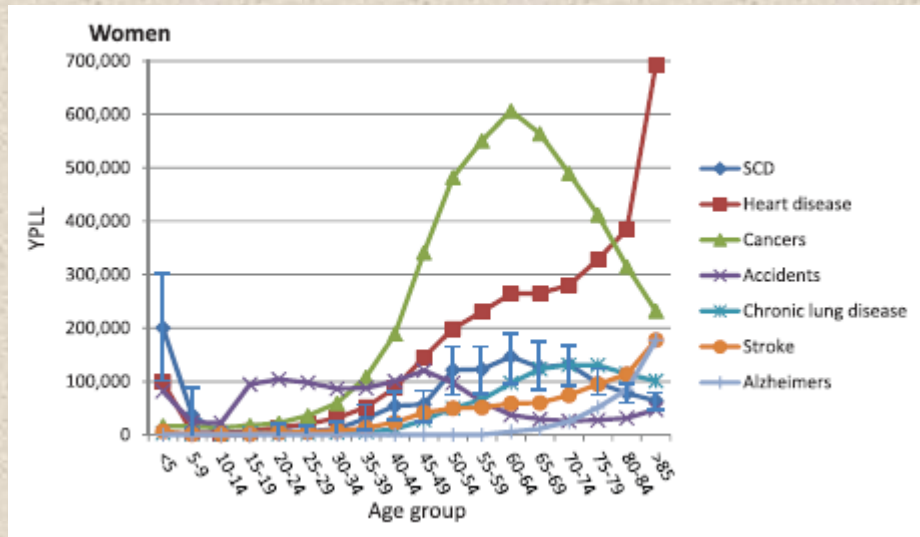
## Male Mortality for Sudden Cardiac Death, Common Diseases, and Individual Cancers

Disease	No. of Deaths	Death Rate
<b>Overall heart disease</b>	<b>308.619</b>	<b>205</b>
<b>Sudden cardiac death</b>	<b>114.948 (99.722-131.505)</b>	<b>76 (66-87)</b>
<b>Overall cancer</b>	<b>296.763</b>	<b>197</b>
Lung cancer	88.527	59
Prostate cancer	28.464	19
Colorectal cancer	26.923	18
<b>Accidents</b>	<b>75.022</b>	<b>50</b>
<b>Chronic lower respiratory disease</b>	<b>65.119</b>	<b>43</b>
<b>Cerebrovascular disease</b>	<b>52.073</b>	<b>35</b>
<b>Diabetes mellitus</b>	<b>35.054</b>	<b>23</b>



# Sudden Cardiac Death Burden

Years of potential life (YPLL) lost among women and men from sudden cardiac arrest and other leading causes of Death



# Out-of-Hospital cardiac arrest

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**n = 515 pts**

**72% male**

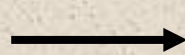
**age 62 ± 9 yrs**

**history of cardiac disease 54%**

**SCA**

**53% women**

**44% men**



**first manifestation of heart disease**

**MI – SCA 6. Median 5 yrs**





# Out-of-Hospital cardiac arrest

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**Yearly incidence of SCA**

**~ 10 / 10.000**



# Out-of-Hospital cardiac arrest

## Contribution of SD to Total Mortality in Relation To Gender in Different Age Groups

Age (yr)	Men		Women	
	All deaths	No. (%) of SDs	All deaths	No. (%) of SDs
25-44	97	8(8)	68	11 (16)
45-54	139	29 (21)	82	7 (8.5)
55-64	351	95 (27)	169	21 (12)
65-74	713	137 (19)	411	67 (16)
<b>Total</b>	<b>1,300</b>	<b>269 (21)</b>	<b>730</b>	<b>106 (14.5)</b>



# Out-of-Hospital cardiac arrest

## Site of Sudden Cardiac Arrest in 501 Victims

	No.	%
At home	399	79.6
On street	47	9.4
Public place	31	6.2
Other places	16	3.2
At general practitioner's home	4	0.8
At work	4	0.8



# Sudden Cardiac Death

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- **First manifestation of heart disease in ~ 50% of cases**
- **~ 60% of cardiac deaths are SCD**
- **women > men VF at resuscitation attempt**
- **~ 80% of SCD occur at home**

# Incidence of sudden cardiac death in Germany: results from an emergency medical service registry in Lower Saxony

Eimo Martens<sup>1,2</sup>, Moritz F. Sinner<sup>1</sup>, Johannes Siebermair<sup>1</sup>, Carsten Raufhake<sup>3</sup>,  
Britt M. Beckmann<sup>1</sup>, Stefan Veith<sup>4</sup>, Dieter Düvel<sup>4</sup>, Gerhard Steinbeck<sup>5</sup>  
and Stefan Käab<sup>1,6\*</sup>

Europace 2014;  
doi:10.1093/europace/euu153

# Incidence of sudden cardiac death in Germany

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## What's new?

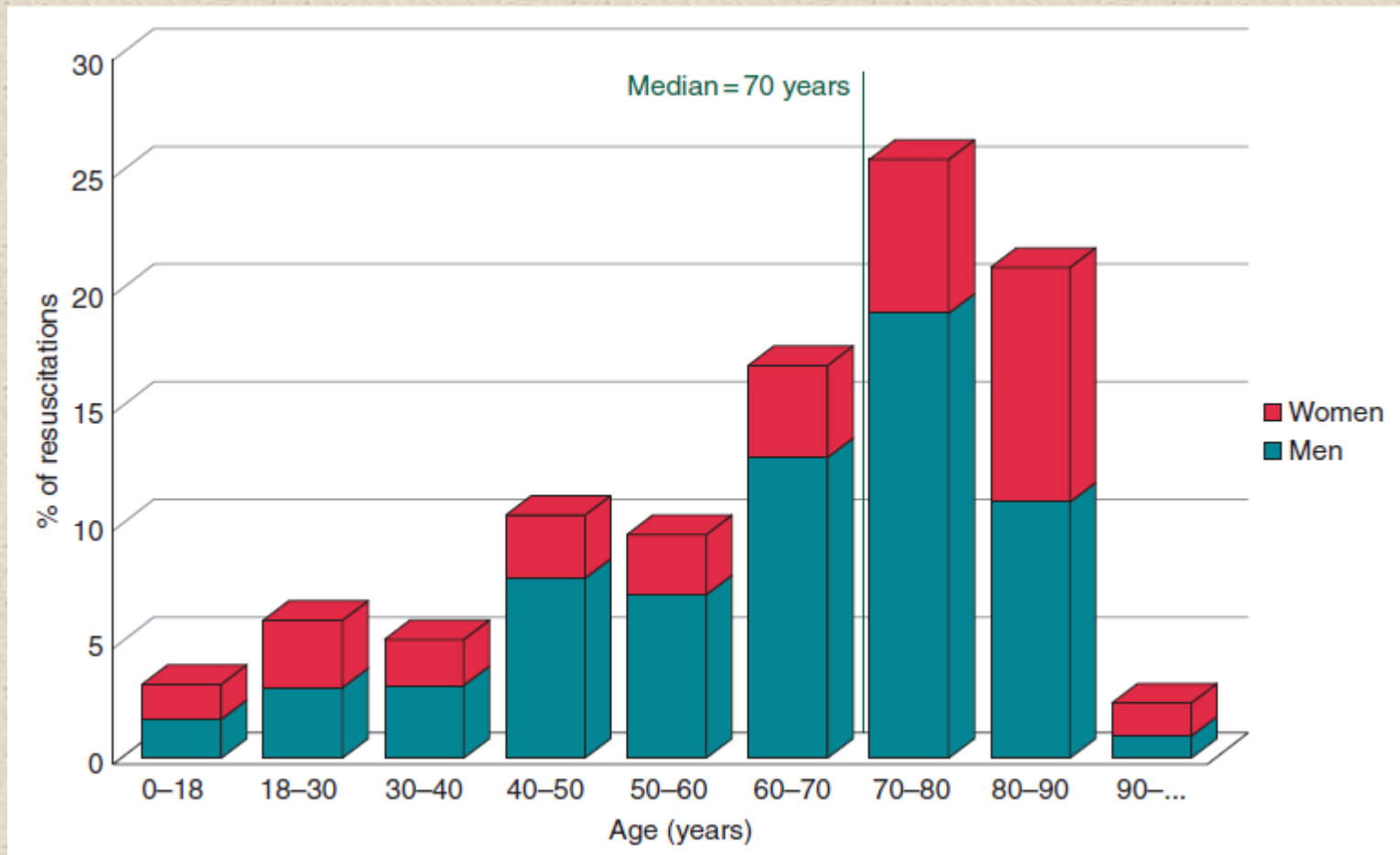
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- We report for the first time a systematic and conservative assessment of incidence of established sudden cardiac death (SCD) in Germany resulting in 81 cases of SCD per 100 000 per year.
  - 34% of SCD occur before age 65.
  - Incidence of established SCD remains stable over an 8 year observation period.
  - Analysis of standardized and homogeneous emergency medical protocols provide important data on the epidemiology of SCD.
  - The clinical problem of SCD needs to be studied on a population level to improve risk stratification beyond the current low ejection fraction recommendation.
- 



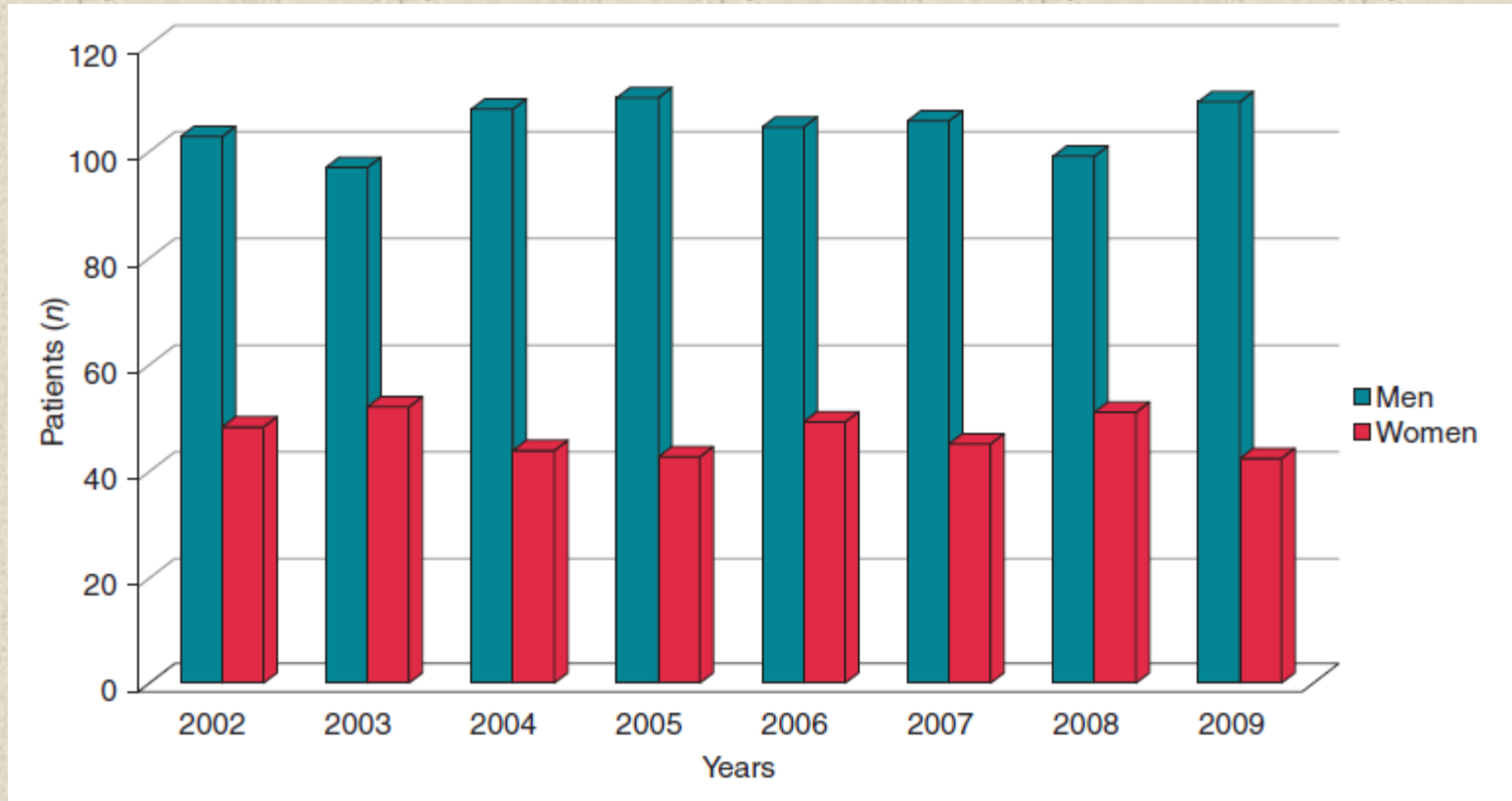
# Incidence of sudden cardiac death in Germany

## Age distribution of SCD cases from 2002 to 2009



# Incidence of sudden cardiac death in Germany

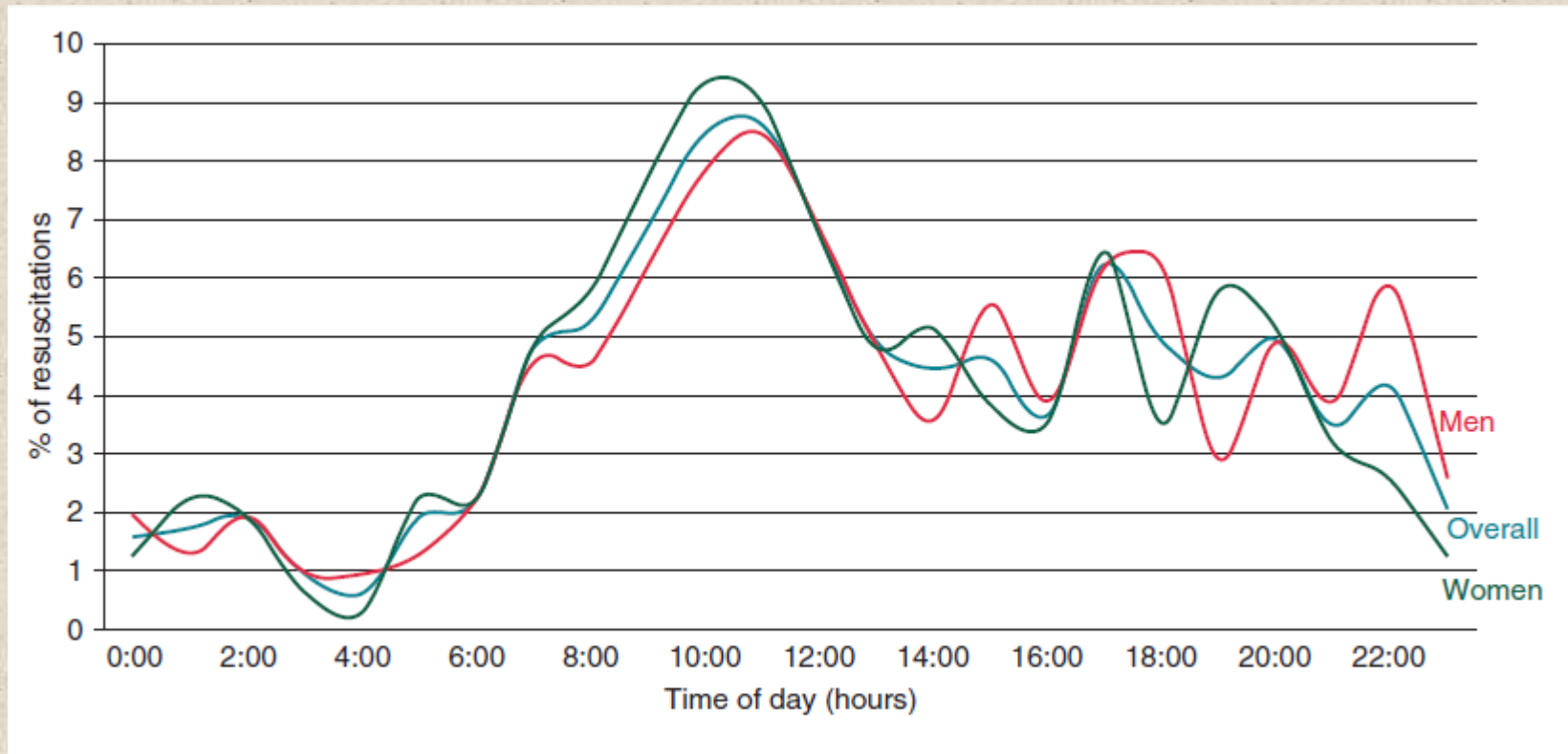
## Sex distribution of SCD cases from 2002 to 2009





# Incidence of sudden cardiac death in Germany

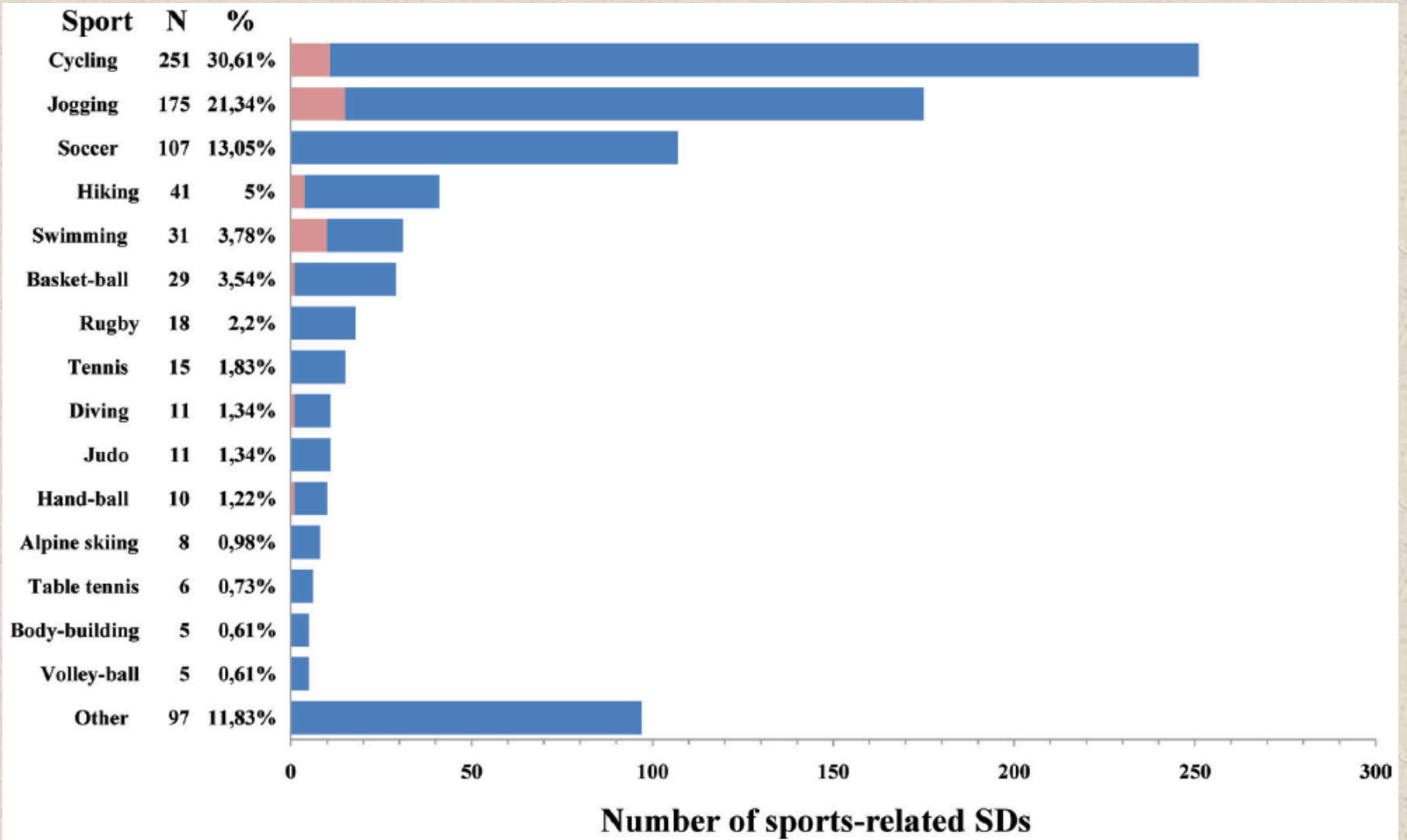
## Circadian distribution of SCD event, averaged from 2002 to 2009







# Sport and sudden death

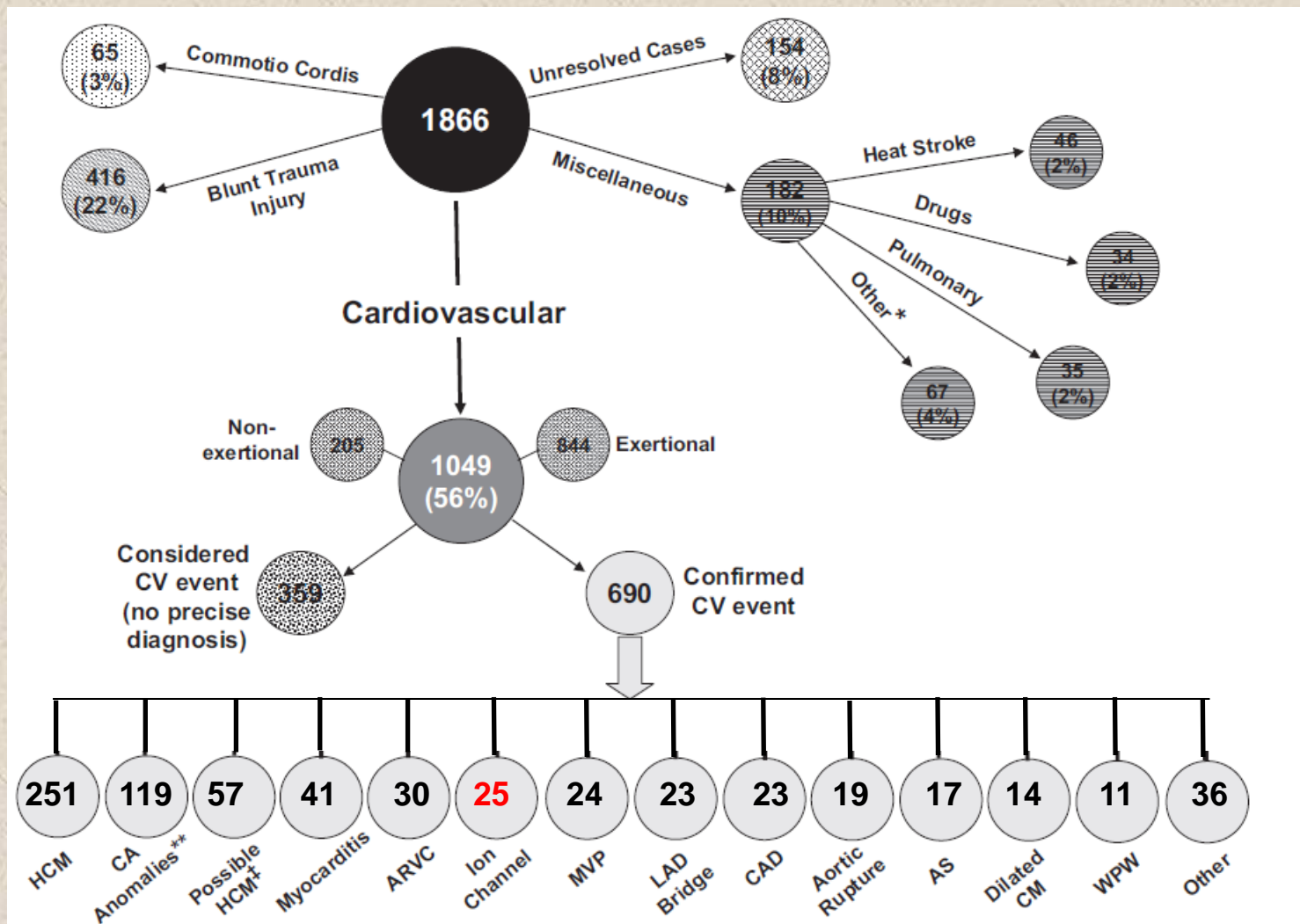


Marijon et al. Circulation 2011; 124: 672-681



# Sudden Death in Young Athletes

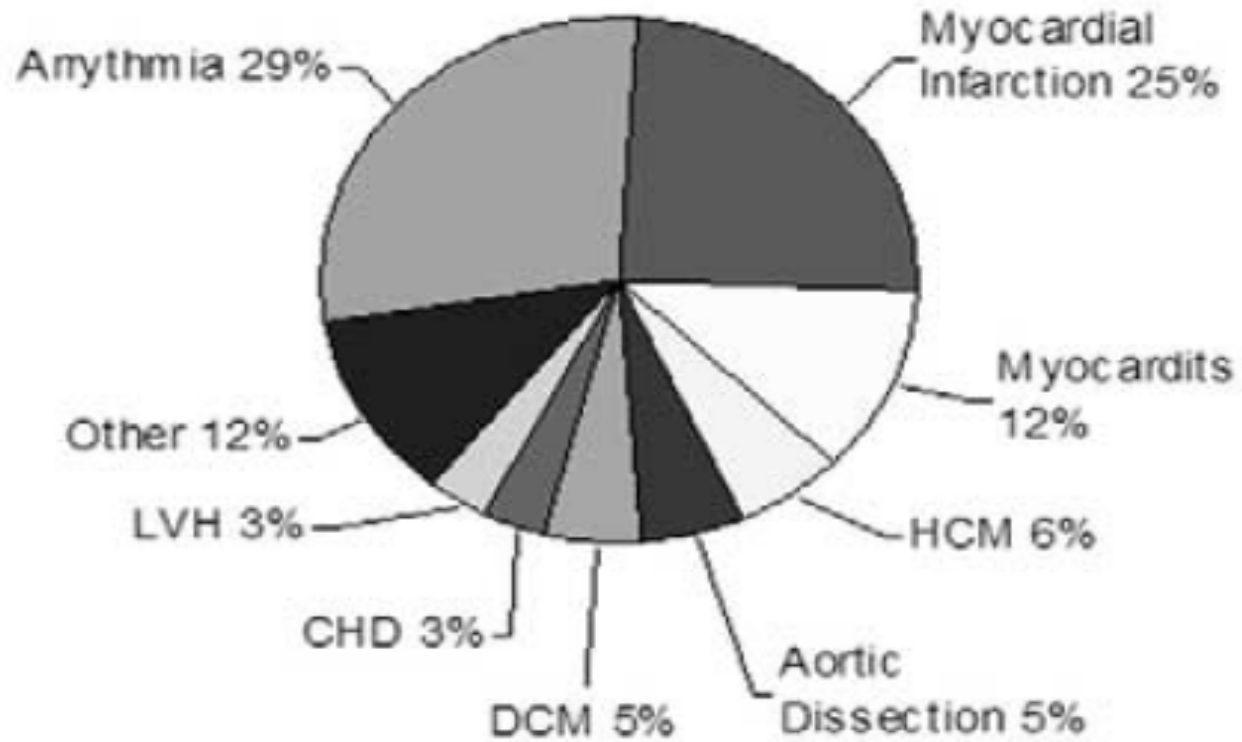
## Causes of death in 1866 young competitive athletes



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



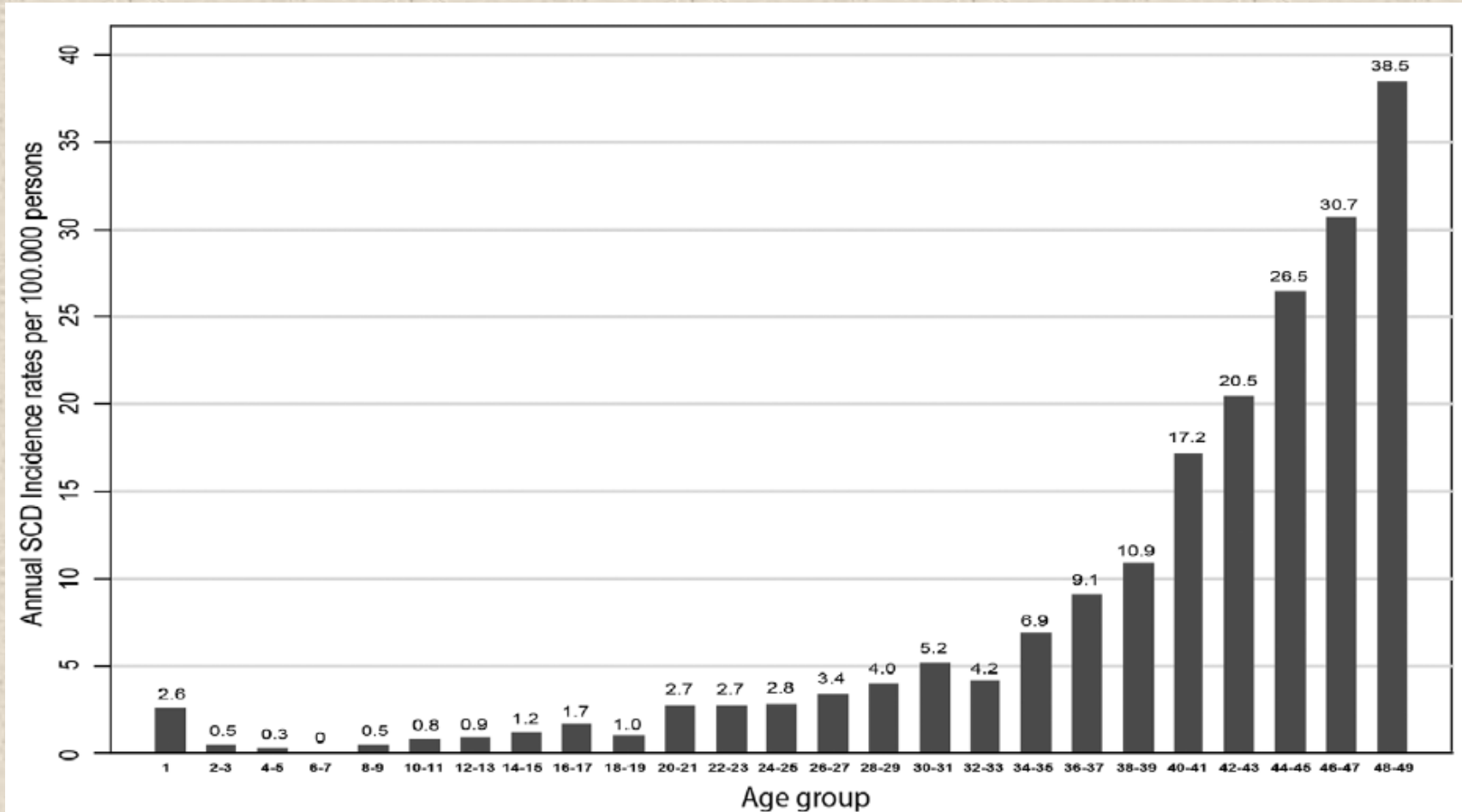
## Cardiac Deaths (n=241)



Puranik et al, Heart Rhythm 2005; 2: 1277-1282

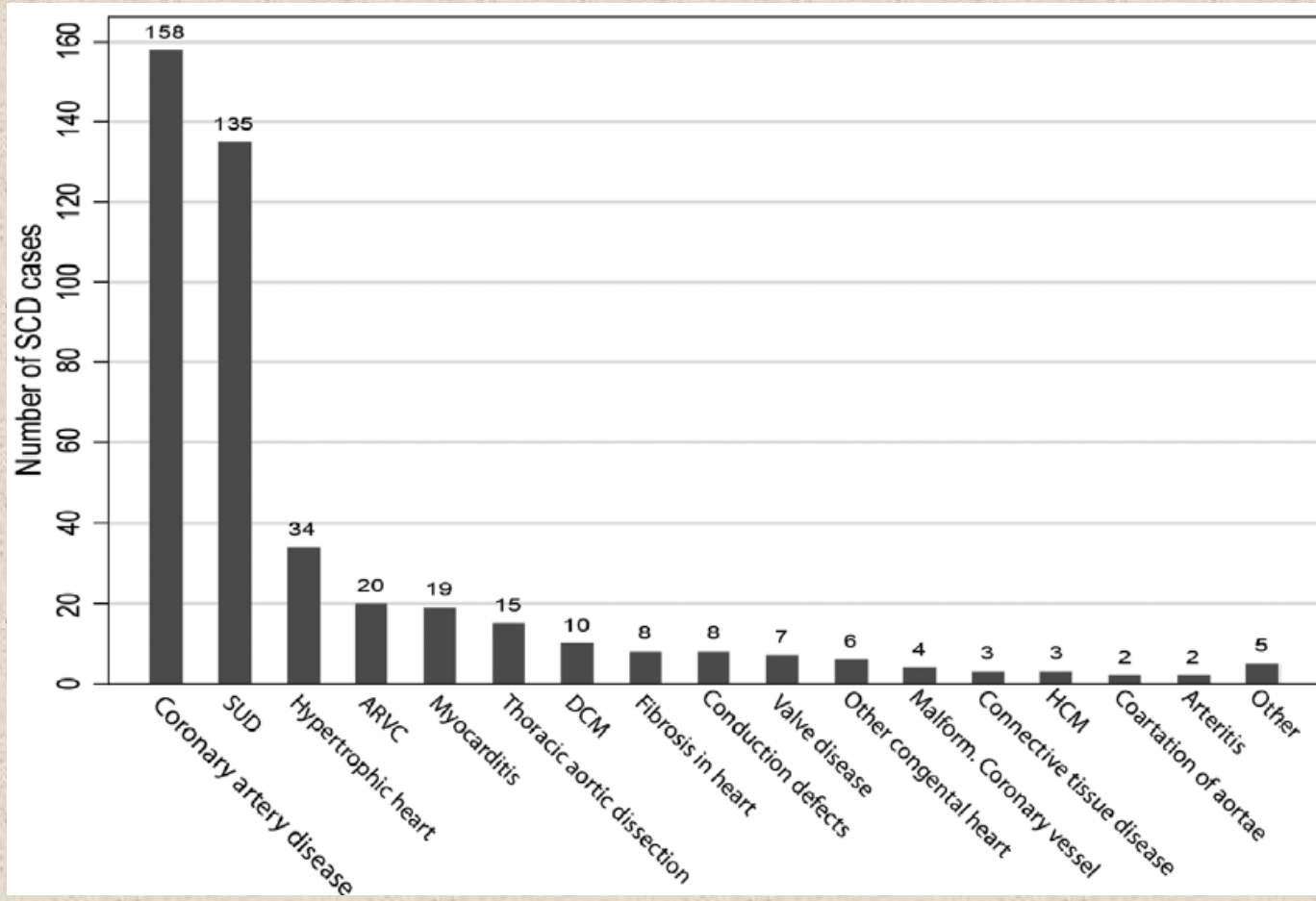
# Sudden Cardiac Death

Age-related distribution of the annual SCD incidence rate per 100.000 persons in persons aged 1 to 49 years in Denmark 2007-2009



# Sudden Cardiac Death

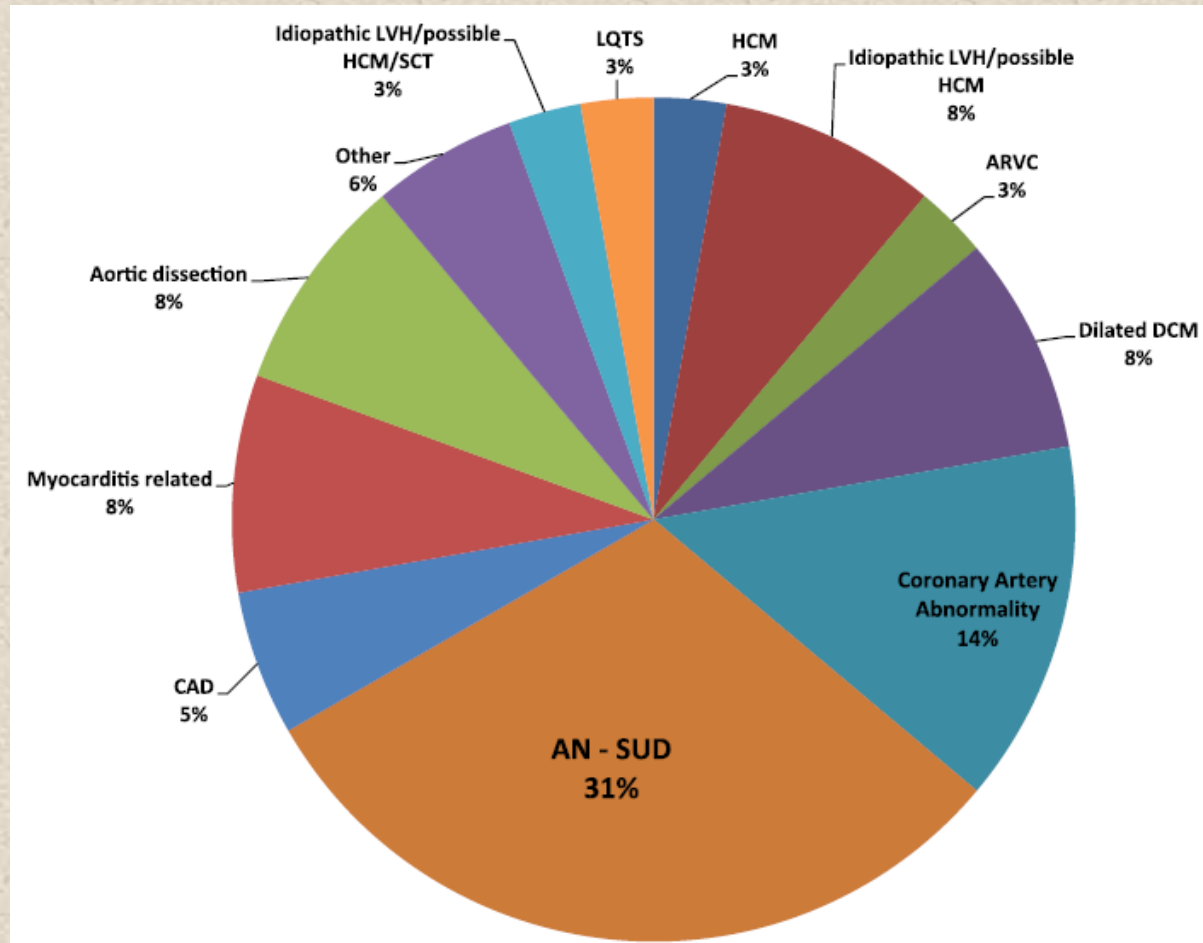
Distribution of the causes of death in the 439 autopsied cases of sudden cardiac death (SCD) in persons aged 1 to 49 years in Denmark in 2007 to 2009





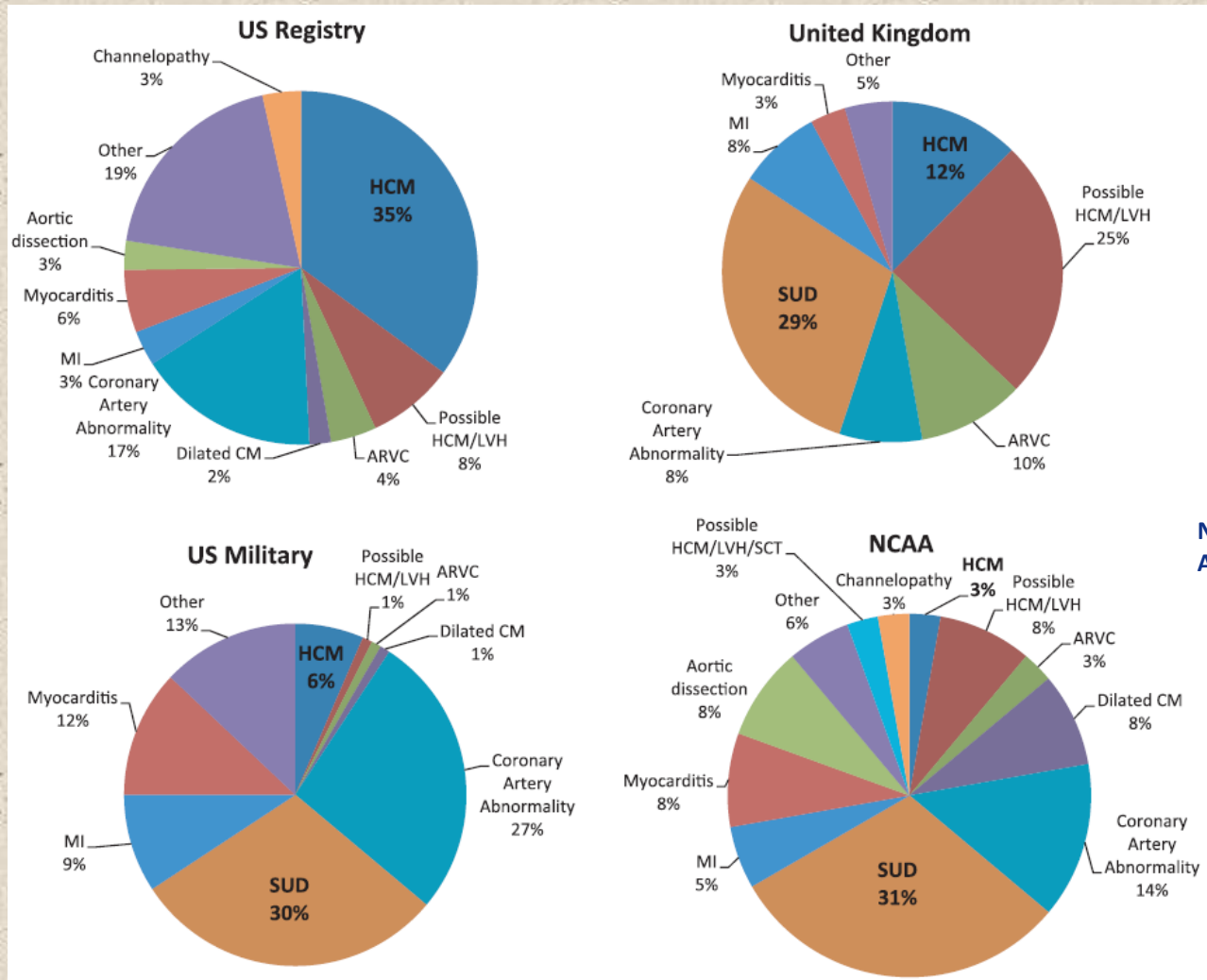
# Sudden Cardiac Death

## Pathogeneses of SCD in National Collegiate Athletic Association athletes



# Sudden Cardiac Death

## Comparison of pathogeneses of sudden cardiac death



NCAA - National Collegiate Athletic Association

# **Incidence, Causes, and Survival Trends From Cardiovascular-Related Sudden Cardiac Arrest in Children and Young Adults 0 to 35 Years of Age**

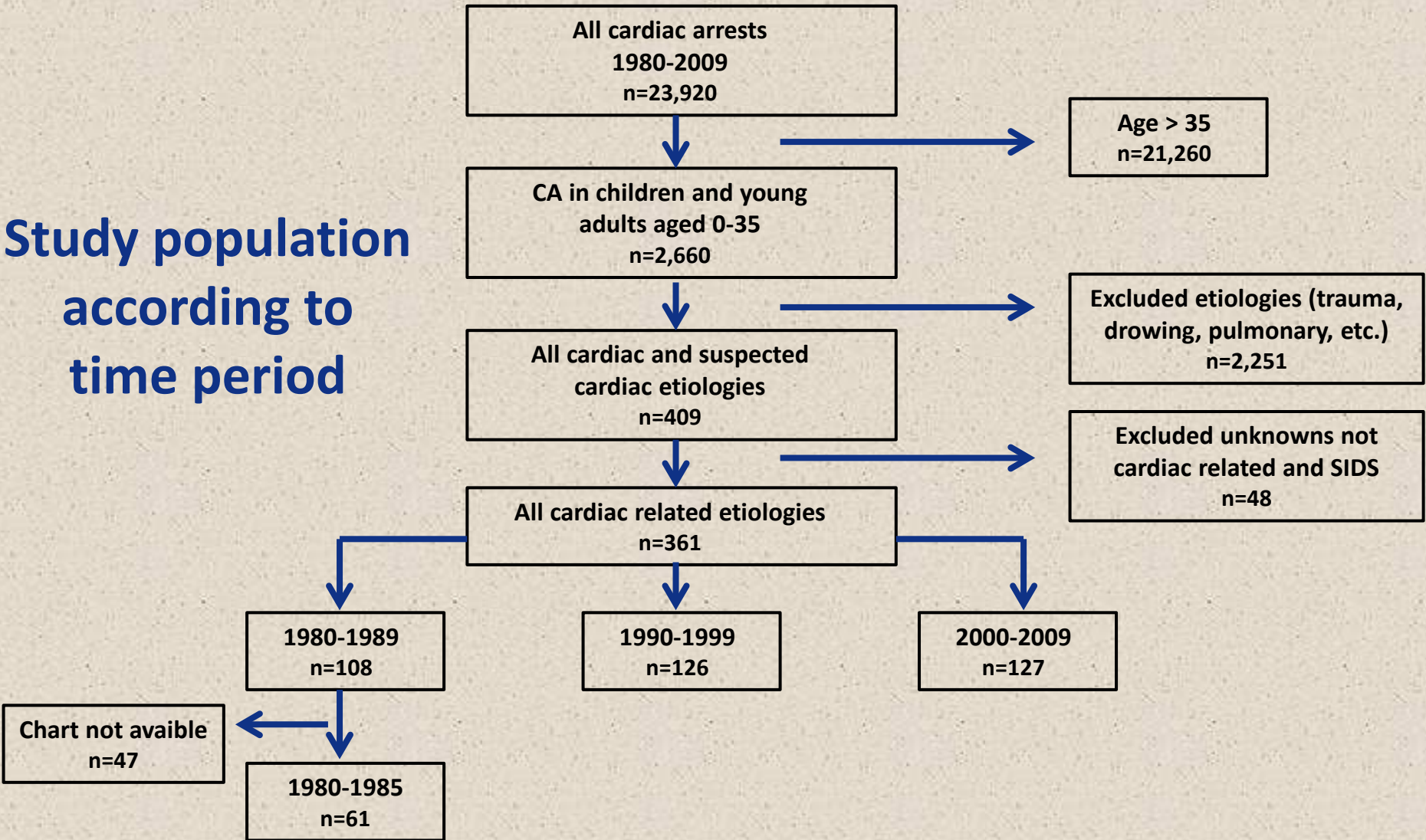
## **A 30-Year Review**

Lauren Meyer, BS; Benjamin Stubbs, MS; Carol Fahrenbruch, MSPH;  
Chris Maeda, MD; Kimberly Harmon, MD; Mickey Eisenberg, MD; Jonathan Drezner, MD

**Circulation 2012;126:1363-1372**

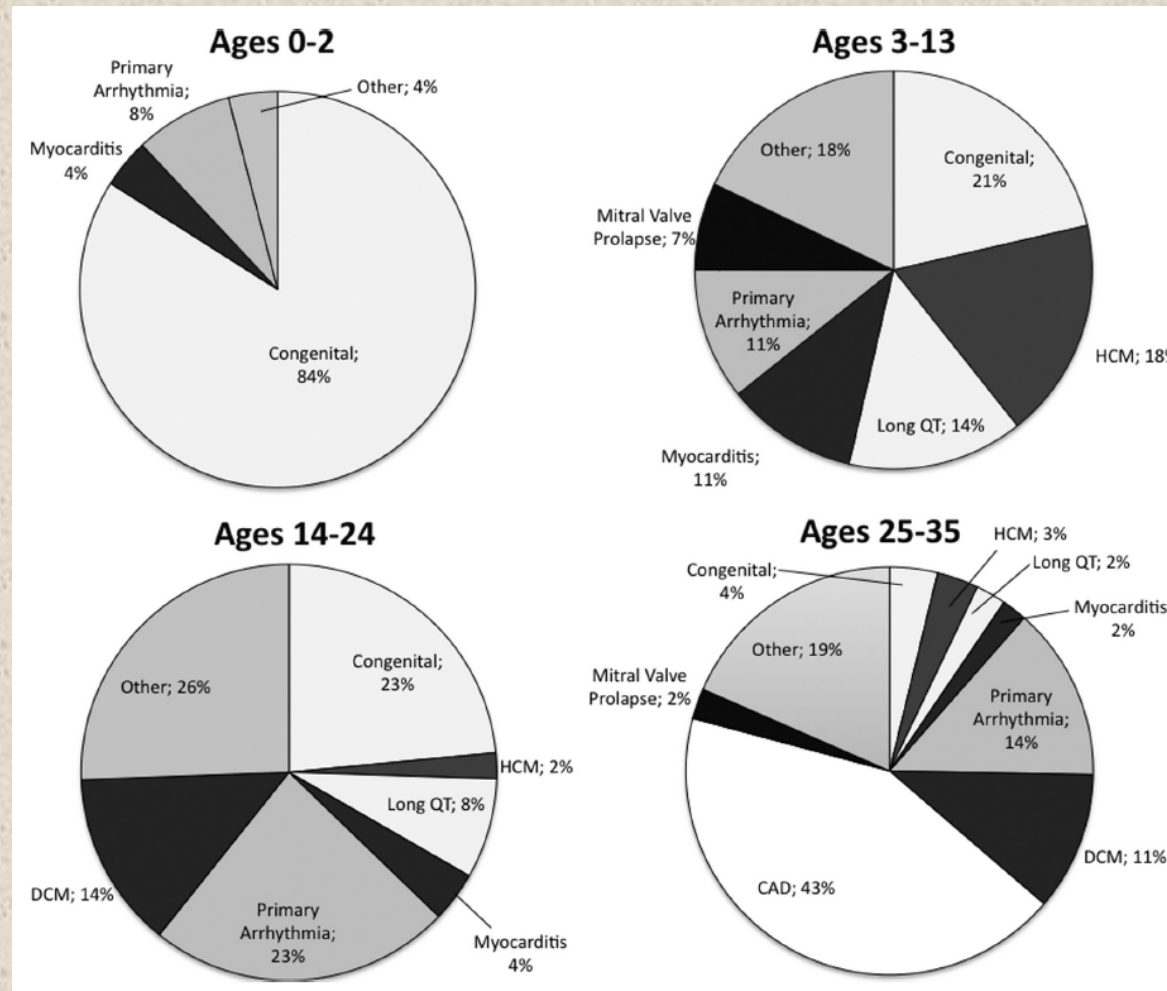
# Sudden cardiac arrest in children and young adults

Study population according to time period



# Sudden cardiac arrest in children and young adults

## Causes of arrest by age group

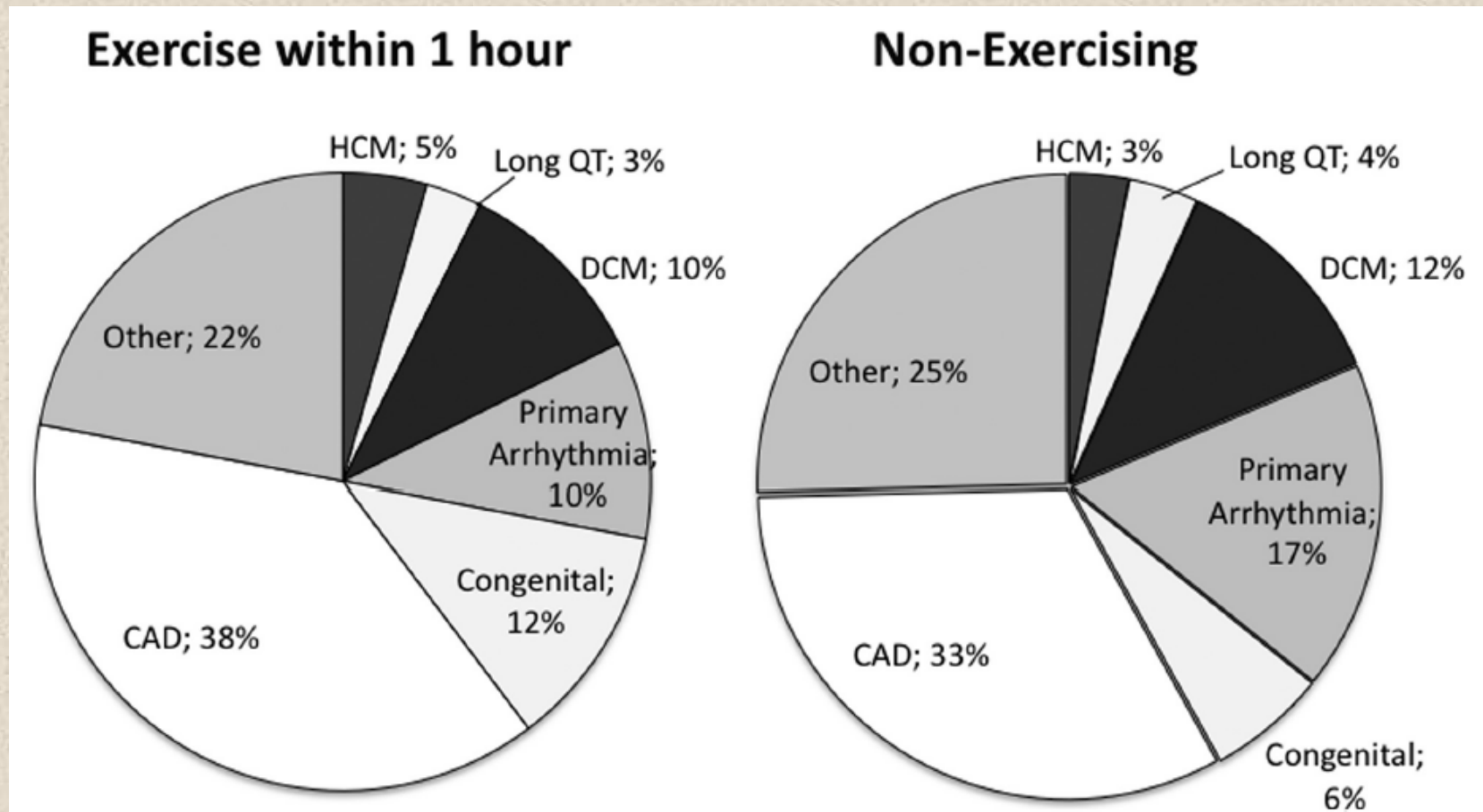


Meyer et al. Circulation 2012;126:1363-1372



# Sudden cardiac arrest in children and young adults

## Exercise- and non-exercise-related causes in individuals 14 to 35 years of age



# Sudden cardiac arrest in children and young adults

## Specific Causes of Out-of-Hospital Cardiac Arrest in Persons 0 to 35 Years of Age

Cause	Causes, n	survival, n(%)	Cause	Causes, n	survival, n(%)
<b>Primary electric</b>	<b>70</b>	<b>36 (51.4)</b>	<b>Other</b>	<b>25</b>	<b>4 (16.0)</b>
Arrhythmia other	5	5 (100.0)	Anomalous origin of coronary arteries	2	0 (0.0)
Commotio cordis	1	1 (100.0)	Aortic dissection/Marfan syndrome	2	0 (0.0)
Long QT	13	9 (69.2)	Cardiomegaly	5	0 (0.0)
Presumed primary arrhythmia	46	18 (39.1)	Coronary arteritis	1	0 (0.0)
WPW	5	3 (60.0)	Dysrhythmia, other structural disease	2	0 (0.0)
<b>Cardiomyopathic</b>	<b>60</b>	<b>25 (41.7)</b>	LV rupture	1	0 (0.0)
ARVC	5	0 (0.0)	Mitral valve prolapse	8	2 (25.0)
Dilated cardiomyopathy	30	17 (56.7)	Pericarditis	1	0 (0.0)
HCM	14	7 (50.0)	Valvular disease	3	2 (66.6)
LV noncompaction	1	1 (100.0)			
Myocarditis	10	0 (0.0)			
<b>Coronary artery disease</b>	<b>90</b>	<b>14 (15.6)</b>			
<b>Congenital</b>	<b>47</b>	<b>3 (6.4)</b>			
<b>Cardiac unspecified</b>	<b>22</b>	<b>10 (45.5)</b>			
<b>Total</b>	<b>314</b>	<b>92 (29.3)</b>			



# Scope and nature of sudden cardiac death before age 40 in Ontario: A report from the Cardiac Death Advisory Committee of the Office of the Chief Coroner

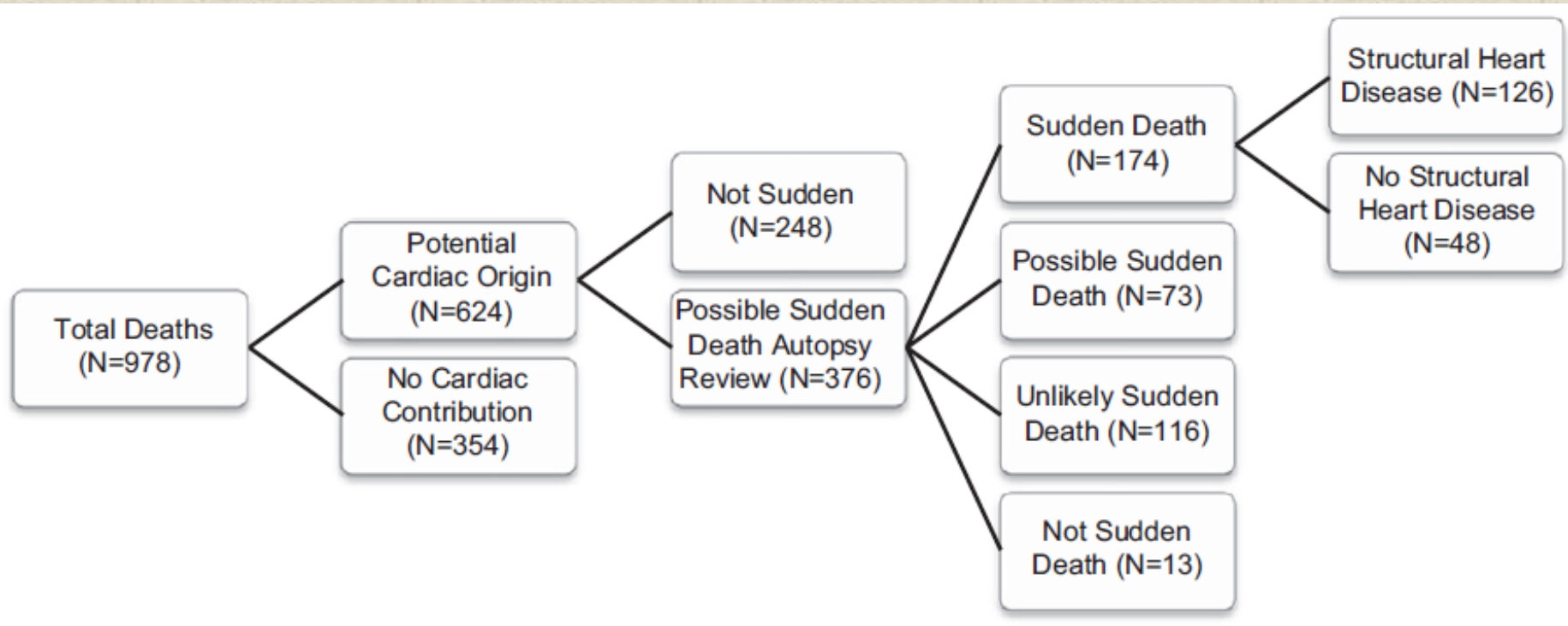
Caileigh M. Pilmer, BSc,<sup>\*</sup> Bonita Porter, MD,<sup>†</sup> Joel A. Kirsh, MD,<sup>‡</sup> Audrey L. Hicks, PhD,<sup>§</sup>  
Norman Gledhill, PhD,<sup>||</sup> Veronica Jamnik, PhD,<sup>||</sup> Brent E. Faught, PhD,<sup>¶</sup> Doris Hildebrandt, BA,<sup>†</sup>  
Neil McCartney, PhD,<sup>¶</sup> Robert M. Gow, MBBS,<sup>#</sup> Jack Goodman, PhD,<sup>\*\*</sup> Andrew D. Krahn, MD, FHRS<sup>\*</sup>

**Heart Rhythm 2013; 10: 517-523**



# Sudden Cardiac Death Before Age 40 in Ontario

## Death review and classification of all potential SCDs in Ontario



# Sudden Cardiac Death Before Age 40 in Ontario

Reported SCDs	Total sudden cardiac deaths N=174		Structural heart disease death N = 126
	n	% (95% CI)	% (95% CI)
Non anatomical cause	48	28 (22-35)	
Structural heart disease	126	72 (65-79)	
Ischemic	62	36 (29-43)	49 (41-58)
Nonischemic	57	33 (26-40)	45 (37-54)
Both	7	4 (2-8)	6 (3-11)
Recognized heart disease	28	16 (11-22)	22 (16-30)
2-11 age (y)	9	5 (3-10)	
12-18 age (y)	9	5 (3-10)	
19-29 age (y)	47	27 (21-34)	
30-40 age (y)	109	63 (55-59)	
Sex: male	133	76	
Reported prodrome (specific)	51	29 (23-26)	
Reported prodrome (nonspecific)	29	17 (12-23)	
No reported prodrome	94	54 (47-61)	



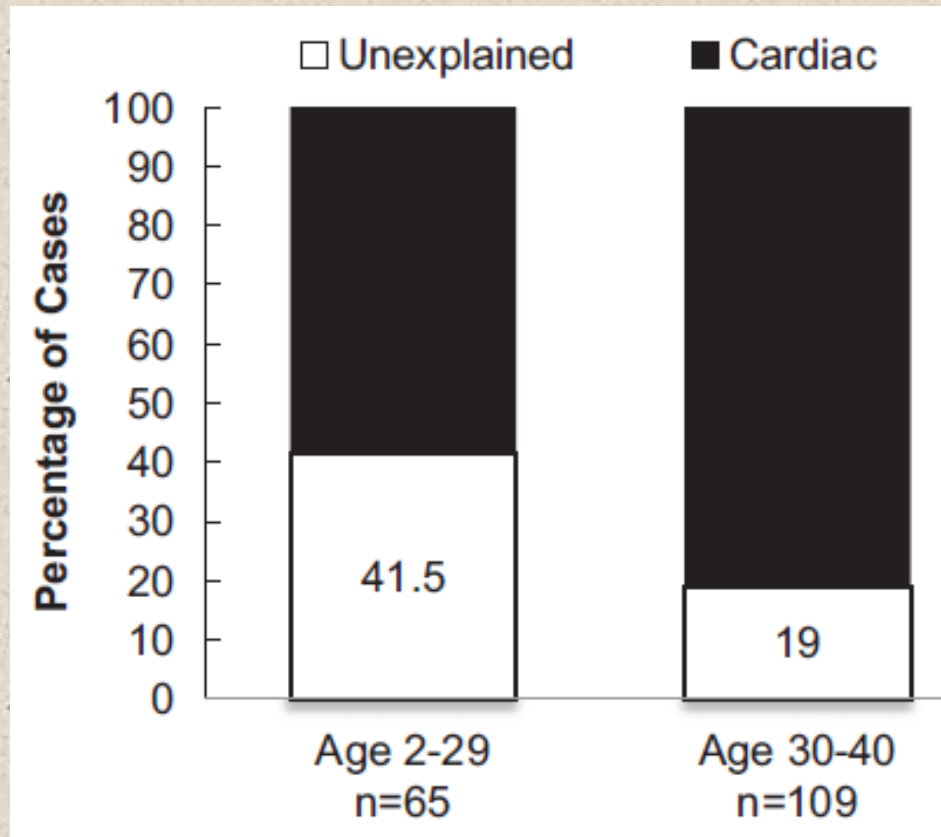
# Sudden Cardiac Death Before Age 40 in Ontario

## SCDs by age

	all	Age(y)			
		≤18	% (95% CI)	>18	% (95% CI)
Sudden cardiac death	174	18	10 (6-15)	156	90 (76-100)
No anatomical cause	48	8	17 (5-28)	40	83 (6-100)
Structural heart disease	126	10	8 (3-13)	116	92 (75-100)
- Ischemic	62	0	0 (0)	62	100 (75-100)
- Nonischemic	57	10	18 (7-28)	47	82 (59-100)
- Both	7	0	0 (0)	7	100 (26-100)
Recognized	28	3	11 (0-23)	25	89 (54-100)
Unrecognized	98	7	7 (2-12)	89	93 (74-100)

# Sudden Cardiac Death Before Age 40 in Ontario

## Cause of SCD by age



# Sudden Cardiac Death Before Age 40 in Ontario

## Detailed causes of death by age group

		Age(y)		
		all	2-18	19-30
Sudden cardiac death	174	18	51	105
No anatomical cause	48	8	21	19
Structural heart disease	126	10	30	86
Ischemic	62	0	13	49
Nonischemic	57	10	17	30
HCM	12	2	4	6
DCM	25	1	7	17
Myocarditis	9	2	3	4
Aortic dissection	9	0	3	6
Cardiac tamponade	5	0	1	4
Endocarditis	2	0	1	1
ARVC	3	2	0	0
Both	7	0	0	7

Pilmer et al. Heart Rhythm 2013; 10: 517-523



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# Conclusions

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- **Sudden death accounts for mortality in 80 cases per 100.000/year**
  - **15% of victims are below 40 yrs**
  - **Primary electrical diseases account for approximately 30% of acute arrests < 40 yrs**
-