

Sudden cardiac death during Endurance Races: is it always preventable?

The RACE Paris Registry (1,073,722 runners)

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<https://www.grci.fr/>

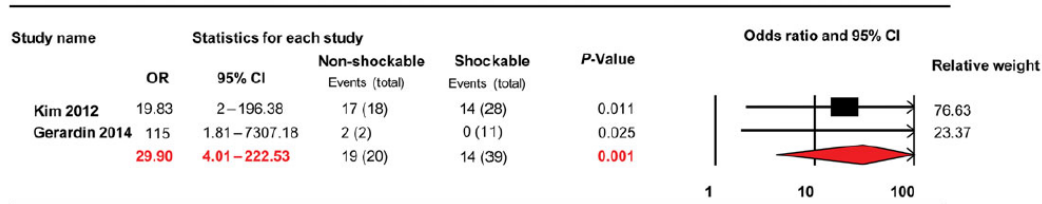


The Paris RACE Registry (2015)

Life-threatening/fatal events during long-distance races (LDR)

- Are rare (3.3/100.000)
- Have a good prognosis
- Most often unpredictable
- Mainly due to myocardial ischemia

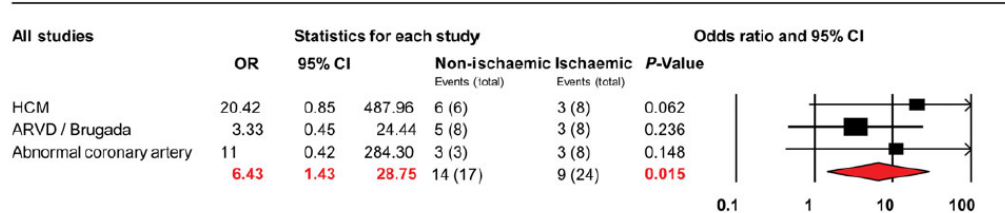
C Lethality according to initial rhythm (non-shockable vs. shockable rhythm)



Heterogeneity: $I^2 = 0\%$

Egger's regression test for publication bias argument; non estimable < 3 studies

Lethality according to aetiology (non-ischaemic vs. Ischaemic)



Heterogeneity: non-estimable

Egger's regression test for publication bias argument; non-estimable

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Study Objectives

- To provide an updated description of the incidence and aetiology of life-threatening events during long-distance races.
- To evaluate the effect of environment of life-threatening events.
- To identify potential risk factors of life-threatening events and survival.

Study Setup

- Investigator-initiated project led and supported by the Groupe de Réflexion sur la Cardiologie Interventionnelle (GRCI), an independent non-profit organization of interventional cardiologists (www.GRCI.fr).
- The protocol was approved by the organizing committees of each race and by the Service Aide Médicale Urgente (SAMU) of the Assistance Publique-Hôpitaux de Paris, responsible for the onsite medical emergency service.

Selection of RACES and Characteristics

- Five types of major LDR (marathon and half-marathon) of the Paris area were prospectively included between Oct 2006 and Sept 2016.
- Runners' characteristics and performance were recorded.
- Weather conditions (temperature, rainfall and humidity) were recorded.
- Pollution index was obtained from the Paris air pollution institute AIRPARIF (www.airparif.asso.fr), using the ATMO index*

* ATMO = National air quality index of background pollution ranging from 1 (no problem) to 10 (most hazardous) measuring the air level of four pollutants: nitrogen dioxide [NO₂], sulfur dioxide [SO₂], ozone [O₃] and microscopic inhalable particles [PM₁₀].

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Cases Selection

- Any adverse events occurring 30min before, during and within 2h after the end of the race were screened for inclusion.
- Primary endpoint → any death or any life-threatening event requiring urgent on-site medical intervention with hospital admission for at least 24h.
- Life-threatening events were categorized as requiring immediate on-site cardiopulmonary resuscitation (CPR) or not.
- The etiology of all major cardiac events was collegially adjudicated after thorough review of all medical records, coronary angiography and interview with survivors.

Exclusion Criteria

- Any hospitalization of less than 24 hours → chest pain with negative hypersensitive troponin
- Rhabdomyolysis with mild renal failure
- Rhabdomyolysis admitted more than 24 hours after the race and needing prolonged hospitalization.

Methodology

- Descriptive and univariate analyses were performed.
- Incidence rates for the total number of cases → proportion of events divided by the number of participants for stated time intervals.
- Meta-analysis of all individual reported life threatening/fatal events reported in long-distance races.
 - “deaths”, “life threatening”, “cardiac events”, “myocardial infarction”, “marathons or half marathons” were keywords used for PUBMED search.
 - Odds ratio (OR) and 95% confidence interval (CI) were determined using Mantel-Haenszel random-effect models.

Study Flow Chart

RACES characteristics

- Mean age was 39.3 years
- 62% of the runners were ≥ 35 year-old
- Female 23% of the total participants
- Average running speed : 10.7km/h
- Lower in M vs. HM (10.1km/h vs 10.9km/h)
- Average discontinuation rate was 2.0%
- Higher in M vs. HM (3.5% vs 1.2%)
- Average outside temperatures
 - ≥ 10 and $< 20^{\circ}\text{C}$ in 60.8%
 - $< 10^{\circ}\text{C}$ (50°F) in 31.8%
 - $\geq 20^{\circ}\text{C}$ (68°F) in 7.4%
- ATMO >8 in 2 (4.3%) races (high rates of microparticles (PM10) in both cases).

1,073,722 preselected runners
in 46 consecutive Parisian long-distance races

Excluded *

No medical interventions

Medical interventions without hospital admission

Non-cardiac causes and/or hospitalization < 24 hours

- Vagal faints with rapid recovery (n=16)
- Moderate hyperthermia (n=2)
- Rhabdomyolysis with acute renal failure (n=2)
- Chest pain and negative medical check-up (n=8)

Life-threatening events (n=36)

Non-cardiovascular events

Exertional heat stroke (n=11)

Major cardiovascular events (n=25)

Sudden cardiac arrest (n=18)

*39 runners seek for medical attention but were excluded either because of admission for < 24 hours or because not qualify as major cardiac events occurring during the race.

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M = marathons; HM = Half-marathons; ATMO = Air quality Index

Baseline characteristics

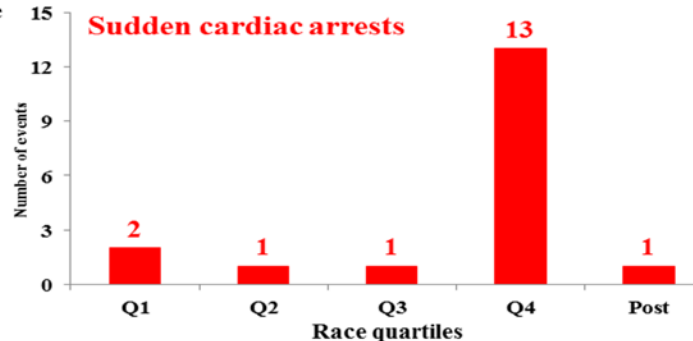
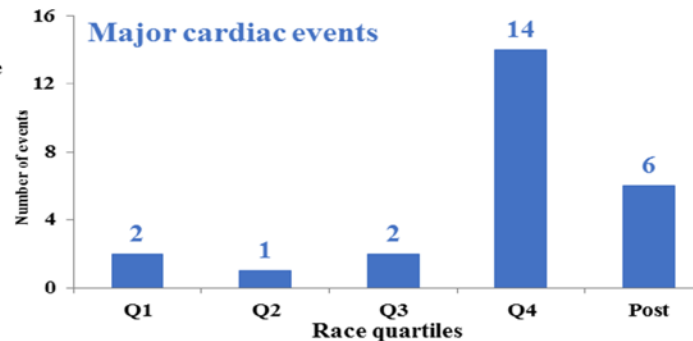
Variables of interest	Number of patients
Male sex	24/25 (96%)
Age, years	41.7 ± 10.0
Any known cardiovascular risk factors	14/25 (56%)
Prior long-distance races	
None	2/25 (8%)
1-5	15/25 (60%)
6-10	3/25 (12%)
>10	5/25 (20%)
Training prior to the index race	
1-3 hours per week	14/25 (56%)
3-5 hours per week	5/25 (20%)
>5 hours per week	6/25 (24%)
Pre-race cardiac testing	
Electrocardiogram	14/25 (56%)
Cardiac stress testing	8/25 (32%)
Type of race during the adverse event*	
Marathon	6/25 (24%)
Half-marathon or equivalent	19/25 (76%)

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Timing of major cardiac events

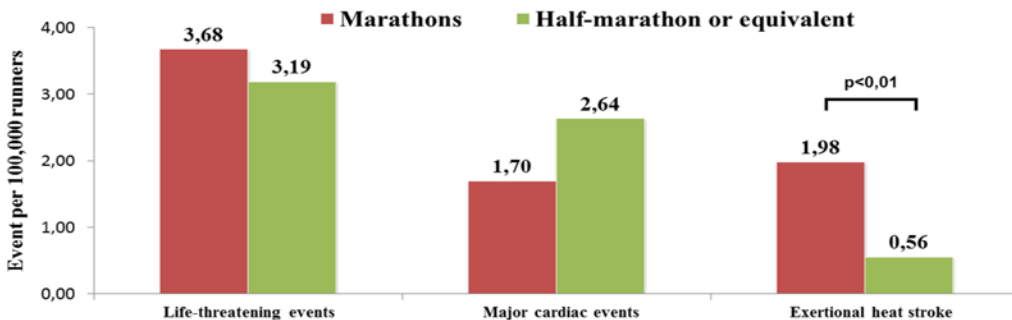
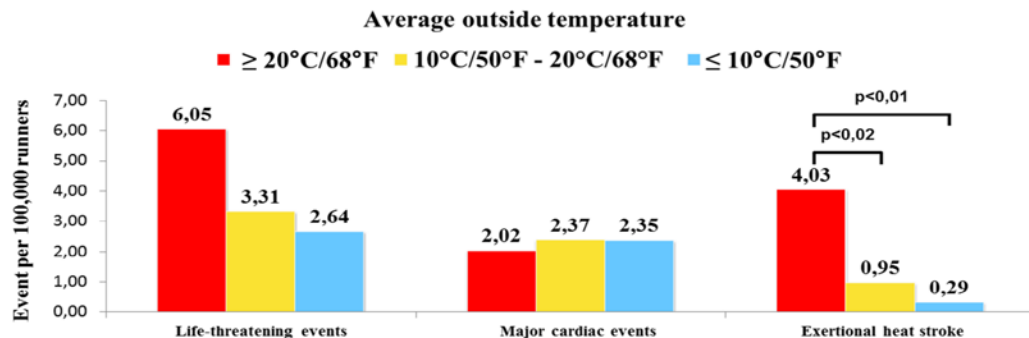


★ Sudden cardiac arrest ★ Other major cardiac event



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Environment Factors



ATMO Index >8
OR 3.27 95%CI 1,12-9,54

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Clinical Presentation

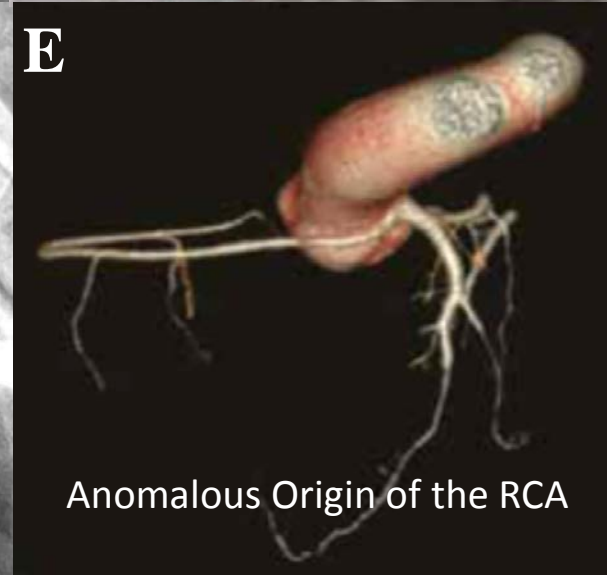
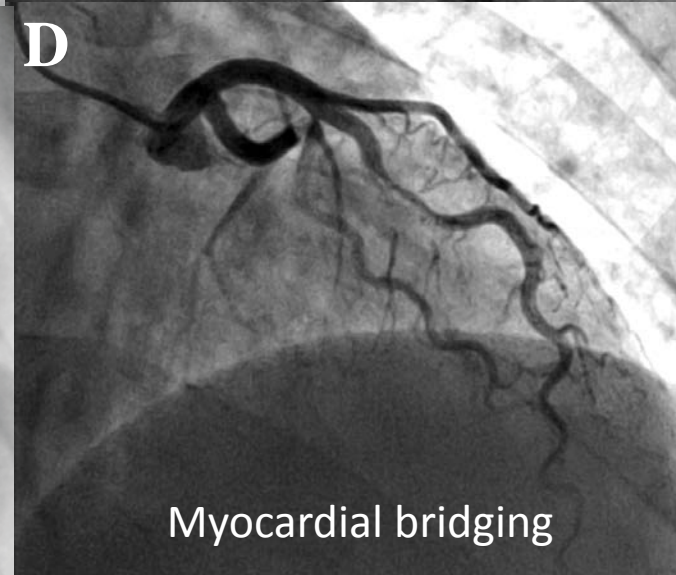
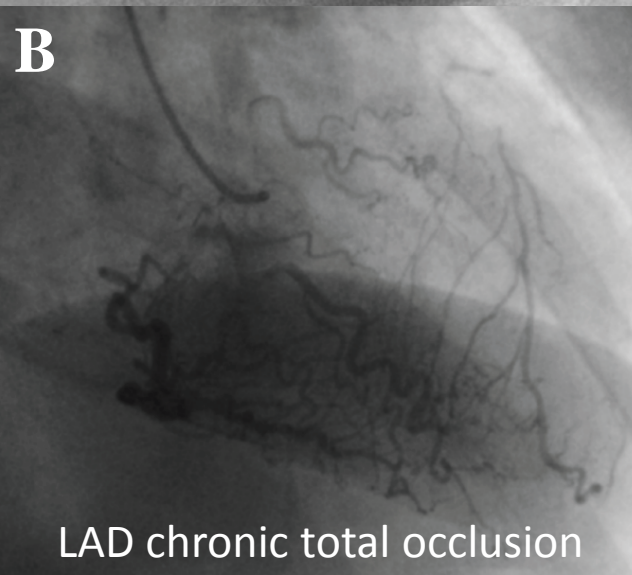
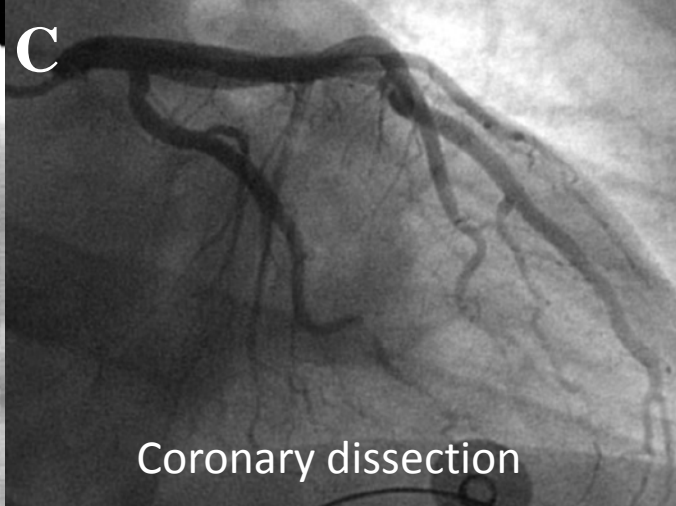
Variables of interest	Number of patients
Type of life-threatening events	
– <i>Cardiac arrest with ventricular fibrillation</i>	11/25 (44%)
– Cardiac arrest with asystole	3/25 (12%)
– Cardiac arrest with sinus rhythm at first medical contact	3/25 (12%)
– Vagal complete atrioventricular block	1/25 (4%)
– Ventricular tachycardia	1/25 (4%)
– <i>Chest pain</i>	5/25 (20%)
– Shock	1/25 (4%)

Pre-RACE symptoms in 1/3

Aetiologies

Variables of interest	Number of patients
Etiology	
Myocardial ischemia	16/25 (64%)
– <i>Acute coronary syndrome</i>	11/25 (44%)
– chronic coronary syndrome	2/25 (8%)
– Anomalous connection of coronary artery	1/25 (8%)
– Spontaneous coronary dissection	1/25 (8%)
– Myocardial bridging	1/25 (8%)
Brugada syndrome	2/25 (8%)
Arrhythmogenic right ventricular cardiomyopathy	2/25 (8%)
Early repolarization pattern	1/25 (4%)
Vagal complete atrioventricular block	1/25 (4%)
Exertional heat stroke complicated by shock	1/25 (8%)
Unknown despite extensive investigation*	2/25 (8%)

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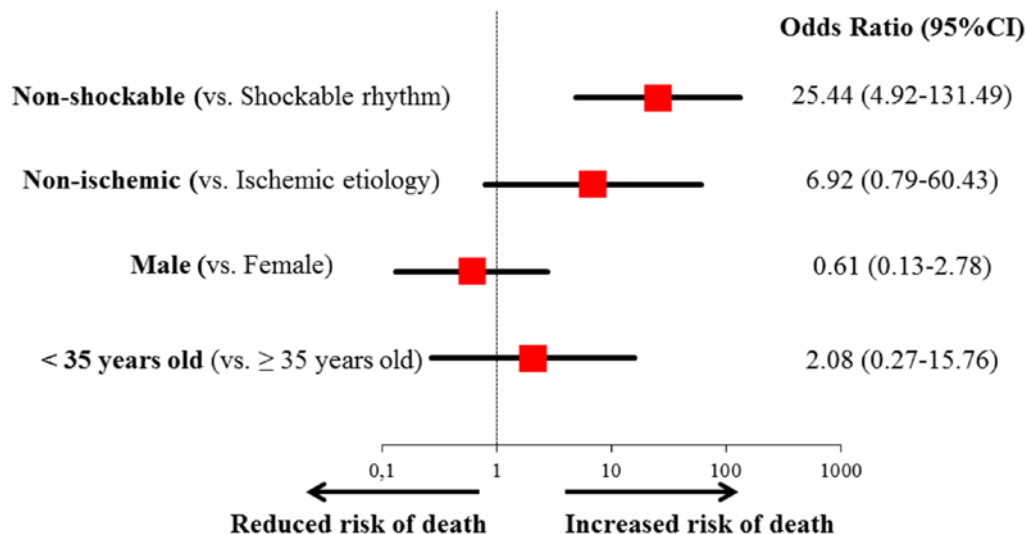
Clinical Outcome

Variables of interest	Number of patients
Treatment	
– Percutaneous coronary intervention	14/25 (56%)
– Coronary artery bypass graft/reimplantation	3/25 (12%)
– Implantable cardiac defibrillator	4/25 (16%)
– Medically managed	4/25 (16%)
Discharged alive	23/25 (92%)

Metanalysis (n=133)

- Incidence of LDR-related SCA → 0.82 per 100,000
- Fatality → 0.39 per 100,000

Risk factors of mortality after sudden cardiac arrest during Long-distance races 8 studies comprising 16,223,866 runners





46 Long-distance Parisian races 2006-2016
1,073,722 runners



Life-threatening events
3.35 per 100,000

Exertional heat stroke
1.02 per 100,000

Pre-race symptoms in a 1/3 of patients with myocardial ischemia

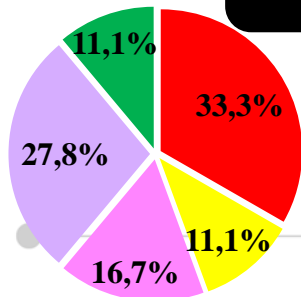


Major cardiac events
2.32 per 100,000

Increased by air pollution
OR 3.27 95%CI 1,12-9,54



Sudden Cardiac Arrest
1.67 per 100,000



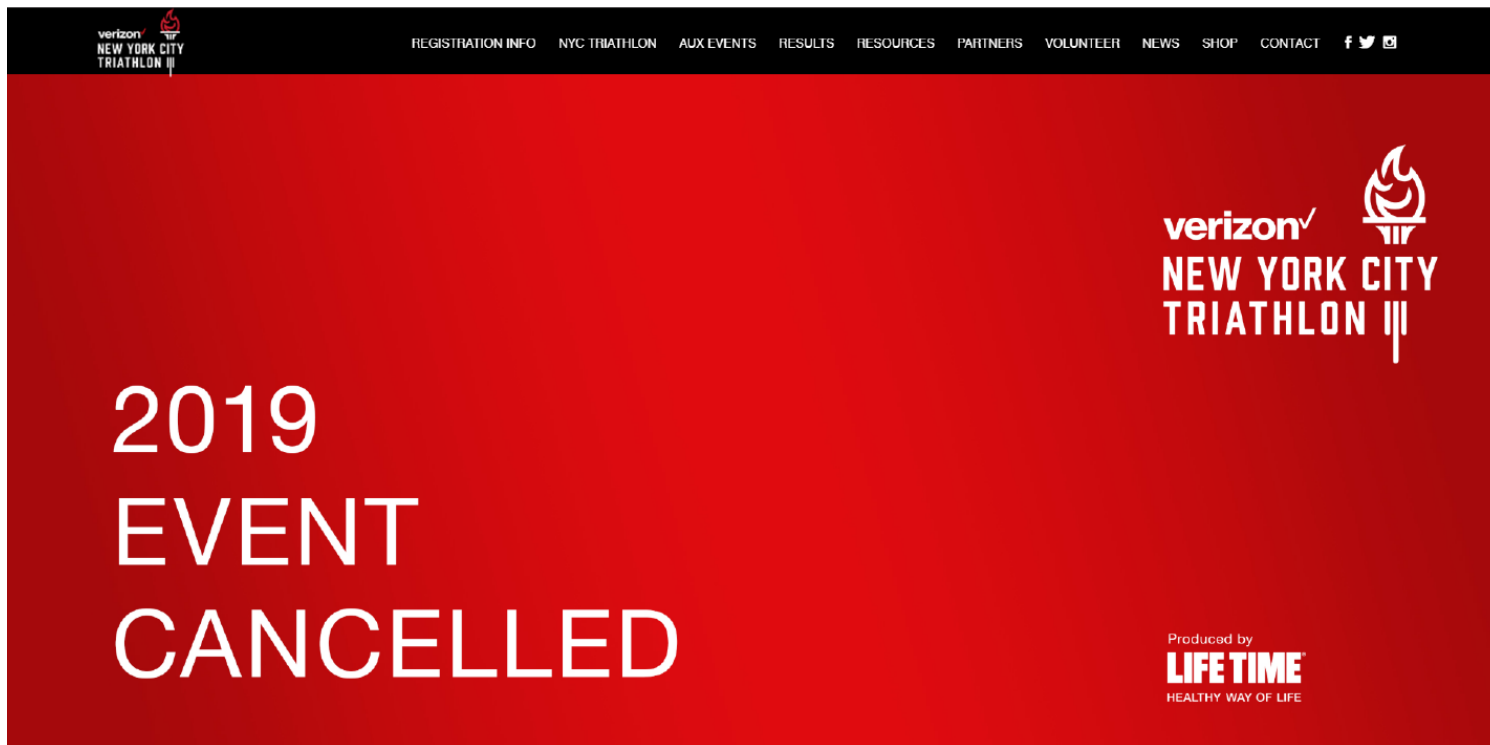
- Acute thrombosis
- Chronic ischemia
- Other coronary abnormalities
- Arrhythmogenic cardiomyopathy
- Unknown origin

Case fatality

- non-ischemic
- asystole

Verizon New York City Triathlon cancelled

On the 19th of July 2019 because of heat and air pollution



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<https://www.nyctri.com/>

Thank you

