

RESEARCH LETTER

# Sudden Cardiac Arrest During Sports in Children and Adolescents

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**S**ports-related sudden cardiac arrest (SrSCA) among children and adolescents is devastating for the child, family, and wider community, yet data on SrSCA in the general pediatric population are almost nonexistent.<sup>1</sup>

We systematically assessed SrSCA pathogenesis in individuals  $\leq 18$  years of age using a large observational prospective cohort study in Germany and the Great Paris Area during a 7-year period, based on a Utstein template with a specific item related to sports activities. Details on methodology have been published.<sup>2,3</sup> The appropriate ethics committees approved the registry (Saarländische Ethik-Kommission approval No. 172/11, CNIL approval No. 912309, and CCTIRS approval No. 12336). Subjects/family members gave informed consent. The authors declare that all supporting data are available within the article.

SrSCA was defined as out-of-hospital cardiac arrest occurring during competitive or recreational sports activities or within 1 hour of sports cessation.<sup>2,3</sup> Causes of SrSCA were centrally adjudicated in both sites. Statistical analysis was performed using R version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria).

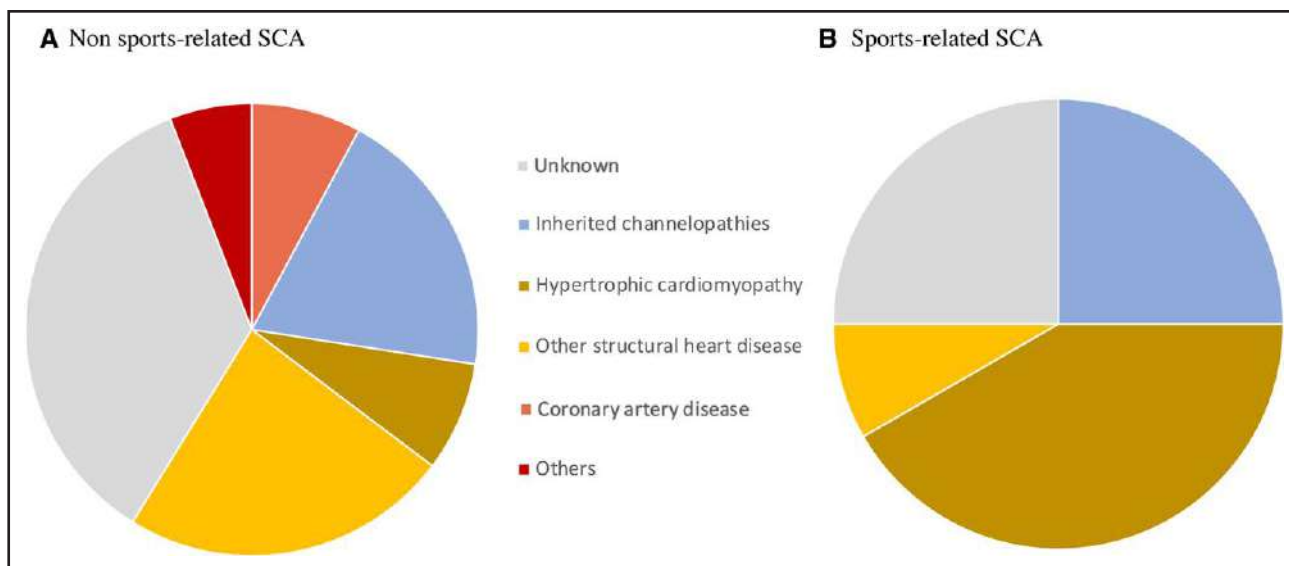
Over a 7-year period, 33 SrSCAs (median age, 15 years [13–17]; 88% male subjects) were recorded, resulting in an incidence rate of 0.25 cases per million children per year (95% CI, 0.01–0.4). SrSCA accounted for 5.4% of overall cases of sudden cardiac arrest in the pediatric population ( $n=15$  of 317 cases in the Paris registry). Most cases occurred during recreational/noncompetitive sports activity, with soccer and running being the most frequently involved sports. All cases were witnessed; however, bystander cardiopulmonary resuscitation (CPR) was

only initiated in 23 cases (72%). Ventricular fibrillation was predominantly noted as the initial rhythm ( $n=21$ ; 84%), with defibrillation with an automated external defibrillator (AED) performed in all of these cases, mainly by emergency medical service personnel (72%). Early AED use by lay bystanders occurred in only 12% of cases. In 14 cases (58%), no AED was available. Cardiorespiratory symptoms preceding SrSCA were reported in only 2 cases. Overall, 12 individuals (36%) survived to hospital discharge, but this percentage was as high as 60% among persons who received both immediate lay CPR and AED use.

A cardiac cause was identified in 24 individuals (92%) and was previously undiagnosed in most cases (96%); hypertrophic cardiomyopathy ( $n=7$ ) and myocarditis ( $n=7$ ; no history of viral infections in the preceding weeks) were the most frequent pathogeneses. The diagnosis of hypertrophic cardiomyopathy was made clinically in all cases by echocardiography and additionally cardiac magnetic resonance imaging in 4 cases. The diagnosis of myocarditis was reached postmortem by autopsy in 4 cases and clinically in 3 cases by imaging (cardiac magnetic resonance imaging) or biopsy. Three cases were assigned to idiopathic ventricular fibrillation. Two cases each were attributed to dilated cardiomyopathy and catecholaminergic polymorphic ventricular tachycardia, respectively. Arrhythmogenic cardiomyopathy, coronary artery anomaly, and premature coronary artery disease (arterial hypertension as cardiovascular risk factor) each accounted for 1 case. Noncardiac causes were diagnosed in 2 cases (1 epileptic seizure and 1 cerebral hemorrhage). Compared with non-SrSCA, most cases of SrSCA with cardiac causes were related to hypertrophic cardiomyopathy or inherited channelopathies (Figure).

**Key Words:** cardiopulmonary reanimation ■ exercise ■ pediatric ■ sudden cardiac arrest

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**Figure. Pathogeneses of SCA, sports-related and unrelated to sports.**

**A**, Non-sports-related SCA. **B**, Sports-related SCA. Based on French data only. SCA indicates sudden cardiac arrest.

### Nonstandard Abbreviations and Acronyms

<b>AED</b>	automated external defibrillator
<b>CPR</b>	cardiopulmonary resuscitation
<b>SrSCA</b>	sports-related sudden cardiac arrest

This comprehensive assessment of SrSCA in the general pediatric population showed that most cases occurred in the recreational sports setting, with a striking male predominance. It is noteworthy that CPR was only performed in 72% of witnessed cases, even lower than what has been reported so far in young or middle-aged sports participants. This highlights the still suboptimal awareness that immediate CPR is important, particularly in very young victims, where there may be a tendency to assume that a serious cause of syncope is less likely. Also, AED use by lay first responders was seen in only a minority of cases, indicating a lack of knowledge on the appropriate use of an AED by lay rescuers. Furthermore, AED availability was limited, which also explains the low survival rate. Thus, specific education on the effective response to cardiac arrest within the community as well as area-wide availability of AEDs are warranted to improve survival rates in children and adolescents; this is amply illustrated by the high proportion of survival among those who received both immediate public CPR and AED use.

In the vast majority of cases, sudden cardiac arrest was the first recognized manifestation of an underlying cardiac pathology. The very low proportion of SrSCA cases with warning symptoms strongly suggests that screening questionnaires reliant on symptoms alone are not an effective strategy for risk stratification in this

age group, in contrast with middle-aged persons with more coronary artery disease-related sudden cardiac arrest.<sup>4</sup> This concern is amplified when considering that the addition of a screening ECG would still not allow the identification of a large percentage of young patients with SrSCA, such as those with myocarditis, catecholaminergic polymorphic ventricular tachycardia, or coronary artery anomalies.

In conclusion, our findings suggest that SrSCA in the pediatric age group occurs predominantly in male adolescents during recreational sports. Increased awareness that SrSCA can also occur in children and improved education on the chain of survival are warranted to improve SrSCA outcomes in this age group. Myocarditis represents the most common cause of pediatric SrSCA together with hypertrophic cardiomyopathy.

### ARTICLE INFORMATION

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**Disclosures**

None.

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