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Severe cardiovascular events among spectators of Spanish professional soccer league before and after COVID-19 onset



Eventos cardiovasculares graves en asistentes a partidos de la liga nacional de fútbol antes y después del COVID-19

Dear Editor,

It has been reported that the incidence of sudden death has seen a significant increase during the COVID-19 pandemic compared to the previous period.¹ This fact is probably related to the higher incidence of arrhythmias and hypercoagulability after infection with the SARS-CoV2 virus.² Attending highly competitive soccer matches causes intense “emotional tension” among attendees, which is a potential trigger for acute coronary syndrome (ACS).³ However, the effect of the COVID-19 pandemic on serious cardiovascular events in those attending high-competition soccer matches in Spain is not known. We hypothesized that serious cardiovascular events among those attending national soccer league matches would have experienced an increase following the COVID-19 pandemic in Spain. To do this, a search was carried out for the events reported in different media from August 2013 to February 6, 2024. The main online search engines (Google and Bing), the social network Twitter/X and the National Library’s digital newspaper archive were used. The search keywords were different combinations of: “dies”, “fan”, “league”, “deceased”, “football”, “heart attack”, “emergency”, “stand”, “match”, “resuscitation”, “cardiorespiratory”, “stroke”. The inclusion criteria were:

- 1 Soccer matches of the Spanish first or second division leagues (other competitions were excluded).
- 2 Experiencing a “serious cardiovascular event” identified as cardiorespiratory arrest and/or myocardial infarction or cerebrovascular event (excluding bronchospasms, heat strokes, “fainting” with immediate recovery, “surges or drops in blood pressure,” etc.).
- 3 Occurrence during the match, in the pregame or immediately after its end.
- 4 The cardiovascular event occurring only to spectators, excluding security personnel, journalists, club workers, etc. For each identified fan, their sex and age were recorded.

Likewise, data on total attendance at stadiums during the analysis seasons was obtained as of 02/06/24 from the website www.transfermarkt.es. In this way, two incidence rates of cardiovascular events were calculated, one that includes the 2013/14 seasons until 2019/20, and another that includes the 2020/21 seasons until February 5, 2023/24. The cut-off point was chosen in the 2019/20 season since the first case of COVID-19 in Spain was recorded on January 31, 2020, suspending professional football competitions just 5 weeks later, which resumed in June behind closed doors.

Incidence rates were calculated as the ratio between the sum of events identified in those periods divided by the number of spectators/attendees accumulated in the respective temporal range, thus having units of events/people per time. For this analysis, a time window of 4 hours per match was considered. The rate comparison analysis was performed with the OpenEpi[®] software, using Fisher’s exact and mid-p tests.

Table 1 shows the cardiovascular events recorded in the study. The links to the websites from which the information was obtained are shown in the Supplementary material. A total of 37 events that met the inclusion criteria were

Table 1 Cardiovascular events in fans attending Spanish first and second division football stadiums between the 2013/2014 and 2023/24 seasons.

Date of media report	Season	Age*	Match	League
13/11/2013	2013/14		Recreativo Huelva-Deportivo	2 nd division
19/11/2013	2013/14		Numancia-Tenerife	2 nd division
13/04/2014	2013/14		Getafe-Atlético de Madrid	1 st division
11/01/2015	2014/15	54	Las Palmas-Zaragoza	2 nd division
22/02/2015	2014/15	63	Elche-Real Madrid	1 st division
22/11/2015	2015/16	51	Deportivo-Celta	1 st division
06/12/2015	2015/16	43	Valencia-Barcelona	1 st division
24/01/2016	2015/16	68	Athletic-Eibar	1 st division
20/02/2016	2015/16		Betis-Sporting	1 st division
04/03/2016	2015/16	61	Espanyol-Betis	1 st division
22/06/2017	2016/17		Tenerife-Getafe	2 nd division
10/09/2017	2017/18	81	Cultural Leonesa-Valladolid	2 nd division
04/11/2018	2018/19		Cádiz-Elche	2 nd division
07/12/2018	2018/19		Leganés-Getafe	1 st division
22/02/2019	2018/19	73	Tenerife-Mallorca	2 nd division
10/03/2019	2018/19		Extremadura-Córdoba	2 nd division
21/09/2019	2019/20		Cádiz-Deportivo	2 nd division
21/10/2019	2019/20		Zaragoza-Mirandés	2 nd division
27/10/2019	2019/20		Las Palmas-Fuenlabrada	2 nd division
20/01/2020	2019/20		Deportivo-Cádiz	2 nd division
23/10/2021	2021/22		Osasuna-Granada	1 st division
01/11/2021	2021/22	60	Oviedo-Málaga	2 nd division
07/11/2021	2021/22	70	Valladolid-Mirandés	2 nd division
12/03/2022	2021/22	82	Atlético de Madrid-Cádiz	1 st division
28/03/2022	2021/22		Oviedo-Fuenlabrada	2 nd division
10/09/2022	2022/23	69	Cádiz-Barcelona	1 st division
18/10/2022	2022/23		Burgos-Mirandés	2 nd division
19/10/2022	2022/23	75	Real Sociedad-Mallorca	1 st division
06/01/2023	2022/23	53	Valencia-Cádiz	1 st division
11/04/2023	2022/23	81	Huesca-Burgos	2 nd division
15/05/2023	2022/23		Levante-Ibiza	2 nd division
22/05/2023	2022/23		Valencia-Real Madrid	1 st division
14/10/2023	2023/24	53	Sporting-Zaragoza	2 nd division
21/10/2023	2023/24		Espanyol-Leganés	2 nd division
10/12/2023	2023/24	64	Granada-Athletic	1 st division
27/01/2024	2023/24		Barcelona-Villarreal	1 st division
29/01/2024	2023/24		Mallorca-Betis	1 st division

* It is only specified in cases where it has been possible to keep the record.

recorded, 20 for the first time period and 17 for the second. Of them, 97% occurred in men. The mean age was 65 ± 12 years, minimum 43 years old, maximum 82 years old (documented in 17 cases). The accumulated number of spectators for the first period was 96699480, while for the second it was 37248658. Overall, the incidence rate was 0.52/10000000 person-hours in the first period or pre-pandemic compared to 1.14/10000000 person-hours for the subsequent period (Fisher's exact test $p = 0.028$; mid-p exact test 0.020). Our study therefore suggests a significant increase in serious cardiovascular events (incidence rate ratio 2.21).

Serious cardiovascular events are fortunately uncommon among those attending soccer matches.³ In a 2005 study carried out in the Barcelona Football Club stadium, the incidence rate of SCA was 0.56/10000000 person-hours, very

similar to what we reported in the pre-pandemic stage.³ The confluence of intense emotions, copious amounts of meals, alcohol, tobacco and perhaps a recent or current SARS-Cov-2 infection mean that football stadiums may be a prone setting for cardiovascular events.

Our study presents the limitations of a retrospective observational study. The limitation is that the sources of information used conditioned a certain imprecision when classifying the events. To avoid this, JAM made a general classification of all the events that LCS later confirmed. This methodology has been previously used in clinical studies.⁴

In conclusion, we observed a significant increase in the incidence of serious cardiovascular events among those attending national soccer league matches in Spain after the start of the COVID-19 pandemic compared to the previous

period. Measures aimed at reinforcing material and human health facilities in Spanish football stadiums could be necessary given these results.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.rceng.2024.04.001>.

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DOI illusion

El espejismo del DOI

Dear Editor,

Digital object identifiers (DOIs) are hyperlinks to guide readers to the origins of online publications. While widely used in the publishing industry nowadays, DOIs are not an essential component of the publishing process. Before the 2000s, scholarly journals operated successfully without DOIs and can still do so.¹¹ Journals now even function in a continuous publishing approach, releasing articles online as soon as they are completed, eliminating the need to wait for a compiled issue and ensuring that readers and professionals stay up to date in their respective fields.¹ Originally crafted to safeguard content from unauthorized reproduction and distribution,² DOIs links have limited utility in scholarly publications, contrary to the claims and praises made about them. In their current form and function, the sole purpose of DOIs is simply to locate online publications to their web sources, no more no less.³ Often composed of obscure symbols and numbers, DOI links lack clarity and meaning, offering no added value over common web links. Not because the DOIs are widely used, they are useful. In print journals or publications, DOI links are meaningless and entirely useless as their function is to locate online content only.

The DOI originated as an industrial tool to facilitate commercial transactions between publishers and customers, aiming to manage permissions and copyright protection, similar to software serial keys. However, this industrial approach falls short in genuinely identifying scholarly contents. DOI links primarily serve as locators for digital publications rather than true identifiers. Additionally, the current DOI management policy harbors a notable flaw in validating software reproducibility, posing some potential security risks.⁴



The value of publications lies in their content and relevance, rather than in the presence or absence of DOI links. The utility of DOIs in science publishing is therefore illusory for several reasons, among them:

- 1 **DOIs and print publications:** DOI links exclusively connect online digital publications to their web sources, making them impractical in print formats. Examining any print publication with a DOI will reveal that its DOI is entirely useless. Printed DOIs links often lack identifying information and cannot be clicked to have such information. If no other argument against DOIs is considered than this, it should be enough to reconsider DOIs value and usability. DOIs are locators rather than identifier or indicators of publication importance or quality, no more, no less.
- 2 **DOIs and persistence:** The idea that DOIs are persistent is a misconception and a complete illusion. If a publication source is moved or its website broken, DOI links become broken as well unless they are updated. DOIs are rather source-dependent, not inherently persistent as it is often proclaimed. Having DOIs does not mean well preserved.⁵ Between 2000 and 2019, more than 170 open-access journals had disappeared from the Internet along with their DOI assigned content.⁶
- 3 **DOI and metrics:** While DOIs can help in scientometrics studies, relying solely on them overlooks essential factors in metrics analysis, including the availability of bibliographic data, readers' interests and attentions, and marketing strategies. DOIs alone do not guarantee importance or visibility; rather, visibility relies on utility and discoverability through search engines, indexing services, and marketing efforts. Altmetrics, which capture the interaction of people on social media, are now part of the outreach package of scholarly publications and impact.⁷ A bibliometric analysis of up to 30 journals of internal medicine in Europe reveals that many of them adhere to high standards⁸ none of these appear to be related to the