



# Sport sciences research and Olympic host countries

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## Introduction

Olympic Games are the most prestigious multi-sport competition in the World. Due to its social and political importance, many countries propose candidate cities to host this competition. One of the alleged reasons to host this competition is the legacy it can generate, which include intangible aspects. Among the intangible legacy, the development of sport sciences is normally cited, because it can contribute to sport personnel enhancement, which consequently might positively influence sports practice and sports performance [1, 2]. Additionally, some countries also invest considerable amounts of resources to figure out between the most successful ones in the medal table, and the contribution of sport sciences in achieving such success has been reported recently [2]. Rees et al. [2] described that specific initiatives were considered successful in Australia and Great Britain. Specifically, these authors [2] indicated that the Australian Institute of Sport has been associated with the increased number of medals won by Australia from only 5 in 1976 Montreal Olympics to 60 medals in the 2000 Sydney Olympic Games. Great Britain's investment in preparation for the Olympic Games increased from £235M in 2008 Beijing Olympics to £261M for 2012 London Olympics, to £355M for 2016 Rio Olympics [2]. A fourth place in Beijing, a third place in London and a second place in Rio Olympics followed these investments. Despite these successful actions, the optimization of procedures grounded on evidence-based approaches has been indicated as the best one for such large investments [2]. Thus, relying on sport sciences scientific production may be a relevant approach.

Analyses in other areas such as dentistry and sports medicine did not indicate an increased number of publications related to the Olympic Games years [3]. In fact, Sotudeh et al. [4] observed no significant relationship between sport sciences scientific production (indexed on Thompson Scientific from 1999 to 2008) and the number of medals in Olympic Games held between these years (i.e., Sydney 2000, Athens 2004 and Beijing 2008). Sports performance is likely not determined solely by the country investment in research, and sport sciences research sometimes has been observed to be far from the desired application [2, 5]. However, the number of papers about Olympic sports was found to be correlated to the medal table in the last Olympic Games edition: papers published about Olympic sports and total medals (Spearman  $r=0.84$ ) and papers published about Olympic sports and gold medals (Spearman  $r=0.70$ ) [5].

Thus, considering the relevance of sport sciences for the improvement of procedures in the athlete preparation and the fact that the Olympic legacy may positively influence the increase in publication in this area, the present study aimed to describe the evolution of sport sciences publications in the countries where the last seven Olympic Games were conducted. The main hypothesis of the present study was that countries hosting the Olympic Games would have an increase in the Sport Sciences scientific production.

## Methods

### Data search

A search in the Web of Science (WOS) (core collection, including SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH and ESCI) was conducted and data about investigations in the Sport Sciences area were retrieved on September 28th, 2017. Data analysis was performed using the WOS “analyze results” database analysis tool. The initial search was performed setting the Research Area to “Sport Sciences” (SU = “Sport Sciences”), chosen because it is considered the most relevant for sports

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performance [2]. All document types (including articles, congress proceedings, letter-to-editor, books, and books chapters) and only articles published were considered separately. After the initial search, data concerning each of the countries from the host cities from the last seven Olympic Games (Barcelona 1992 in Spain, Atlanta 1996 in United States of America, Sydney 2000 in Australia, Athens 2004 in Greece, Beijing 2008 in China, London 2012 in England and Rio de Janeiro 2016 in Brazil) were retrieved. Data from 18 years were collected for each country. Specifically, data between 13 years before, the year of the Olympic Games and 4 years after the Olympic Games for each host country were included in the analysis (exception made to Brazil, as complete data were available only up to the year of the Olympic Games). As the announcement of the host city is made typically 7 years before the Olympic Games, a similar period (i.e., 7 years) was used to represent the scientific production baseline of each country before the host city was confirmed. Extracted items for each country were further counted for each year using WOS native result analysis.

**Statistics**

To minimize the large variability in the number of publications among countries, Z score data for each year within country were considered for the final analysis. We assumed that the number of Sport Sciences publication (*Y*) within a country increases linearly over time at rate “*B*”. We hypothesized that the confirmation of candidacy for hosting the Olympic Game (defined as year = 0) would trigger a change in the rate of Sport Sciences publications in the following years by the amount “delta*B*”. For this purpose, we created a logical auxiliary variable *Post* representing the years before (*Post* = 0) or at and after (*Post* = 1) the confirmation

of candidacy for hosting Olympic Game. Year of publication was also scaled anchoring the candidacy confirmation to 0, negative and positive values representing years before and after that confirmation. A multiple linear regression ( $Y = \text{constant} + B \times \text{year} + \text{delta}B \times \text{Post} \times \text{year}$ ) analysis using ordinary least square method was performed and statistical significance for the slope delta*B* ( $p < 0.05$ ) was tested.

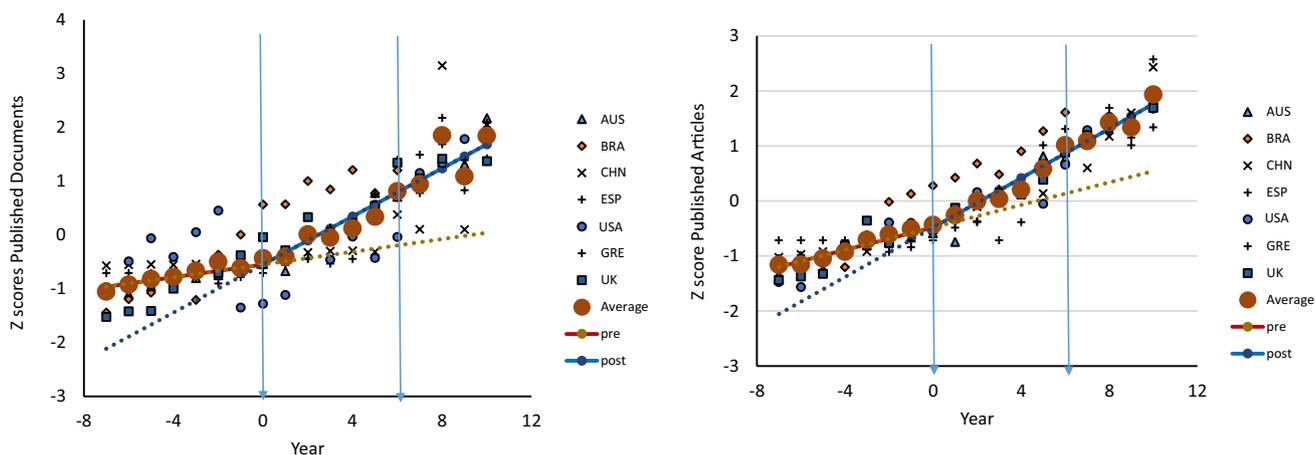
**Results**

Figure 1 presents the Z score of all document type and article publications by the last seven countries with host Olympic cities.

Significant regression for all published document type ( $R^2 = 0.843, p < 0.001$ ) and articles ( $R^2 = 0.897, p < 0.001$ ) was observed. The delta*B* values, which represent the increase in publication rate per year after the confirmation of candidacy for Olympic Games, were also positive and significant for both types of publications (all types: delta*B* = 0.165, SE = 0.035,  $t_{(119)} = 4.675, p < 0.001$ ; articles: delta*B* = 0.122, SE = 0.023,  $t_{(119)} = 5.339, p < 0.001$ ).

**Discussion**

The main findings of the present study were that the Sport Sciences scientific production increased linearly in countries with cities hosting the summer Olympic Games and that this increase was more accentuated after the host city announcement compared to a period before this fact. This is the first investigation to demonstrate a positive impact of hosting the Olympic Games on scientific publications in Sport Sciences,



**Fig. 1** Publications of all types of documents by country [right panel; Z score =  $-0.549 + 0.059 \times \text{year} + 0.165 \times \text{year} \times (\text{year} \geq 0)$  ( $R^2 = 0.843, p < 0.001$ )] and publications of articles by country [left

panel; Z score =  $-0.482 + 0.102 \times \text{year} + 0.122 \times \text{year} \times (\text{year} \geq 0)$  ( $R^2 = 0.897, p < 0.001$ )]

indicating that countries with hosting cities seem to increase its investments in this specific area, probably in an attempt to increase their athletes' performance. This is especially relevant, considering that our analyses considered an 18-year period, including a 7-year period before the announcement of the host city, the 7-year period between the announcement and the Olympic Games year and 4 years after its realization. It is also important to emphasize that the publication rate increased in all types of documents as well as on the higher qualified item (i.e., articles).

The impact of scientific production in Sport Sciences on competitive performance is a topic of debate, but recent evidence suggests that one country using stronger evidence-based approaches and the best available evidence in this field to direct its preparation succeeds in this endeavor [2]. Thus, the increased investment in research or elevated alertness of sport scientists in countries hosting the Olympic Games can contribute to the host country's performance or at least increase the knowledge in this field. Indeed, a recent publication indicated a positive correlation between medal table in Rio Olympic Games and papers related to Olympic sports [5]. Additionally, the increase in publication in Sport Sciences is different from what was reported in other areas less connected to sports performance (e.g., dentistry), where no change was observed in the number of publications [3], or even in Sport Sciences when the period comprising three Olympic Games editions was considered [4].

Certainly, an increased transference of the research-generated knowledge to coaches and sports personnel [2, 5] can contribute to even great investment in Sport Sciences, especially by countries with host cities. Moreover, the increase in the number of articles is one desired approach to contribute to Sport Sciences knowledge increase. Additionally, further investigations should be conducted to verify the impact of Sport Sciences research on high-level competitive performance.

The main limitation of the present study was that the full data for one of the countries hosting the Olympic Games (i.e., Brazil) was not available at the moment our analysis was conducted. This limitation may have affected the regression analysis performed, as less time points were available for this country.

## Conclusion

Sport Sciences scientific production increased linearly in countries with cities hosting the summer Olympic Games and this increase was more accentuated after the host city announcement compared to a period before this fact.

**Author contributions** EF and EK contributed to the conception and design of the study. EF contributed to the development of the search strategy analysis, the acquisition of the data. EK performed the data analysis. Both authors contributed to drafting of the article and revising it critically, and approved the final version to be submitted.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest relating to the publication of this manuscript.

**Ethical approval** This article does not contain any studies with human participants performed by any of the authors.

**Informed consent** For this type of study, formal consent is not required.

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