

# Effect of Elite Sport on Physical Activity Practice in the General Population: A Systematic Review

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**Background:** Our study investigated the effect of elite sport on physical activity (PA) practice in the general population.

**Methods:** Structured Boolean searches were conducted across 5 electronic databases (PubMed, JSTOR, Web of Science, SPORTDiscus, and PsycInfo) from January 2000 to August 2021. Peer-reviewed studies in English were included if the effects of hosting elite sport events, elite sport success, and elite sport role modeling on PA/sport practice in the general population were measured. **Results:** We identified 12,563 articles and included 36 articles. Most studies investigated the effect of hosting elite sport events (n = 27), followed by elite sport success (n = 16) and elite sport role modeling (n = 3). Most studies did not observe a positive effect of hosting elite sport events, elite sport success, or elite sport role modeling on PA/sport practice in the general population. No evidence of a lagged effect of elite sport was observed. No evidence of elite sport effects was observed according to age range and geographical scale. **Conclusion:** There is no evidence supporting the effect of elite sport in increasing PA or sport participation in the general population. Decision makers and policymakers should be aware of this and invest in strategies such as those recommended by the World Health Organization.

**Keywords:** demonstration effect, festival effect, role modeling effect, trickle-down effect, decision and policymakers

Evidence shows that physical activity (PA) confers health benefits for hearts, bodies, and minds and contributes to preventing and treating chronic diseases, such as cardiovascular disease, cancer, diabetes, and depression.<sup>1</sup> Moreover, PA practice generates economic benefits, such as an increase in productivity and a decrease in health care costs.<sup>2,3</sup> However, the majority of the population worldwide does not reach PA recommendations, especially when strengthening activities are considered.<sup>4–8</sup>

PA can be practiced in many ways, including active transportation, work, gardening, housework, active forms of recreation, and sports, and can be promoted using a variety of strategies.<sup>9,10</sup> In addition to PA-friendly environments,<sup>11</sup> PA can be efficiently promoted in daily settings, such as health care systems,<sup>12</sup> schools,<sup>13</sup> and sport clubs.<sup>14</sup> Another widespread strategy involves supporting and promoting elite sport with the aim of inducing an increase in PA/sport practice in the general population, which may lead to a healthier population. That is why this proposed mechanism, also called the trickle-down effect, is often used by decision makers and policymakers to legitimize spending public money to support elite sport events and/or to finance elite sport programs.<sup>15–17</sup>

This trickle-down effect includes 3 mechanisms, which can be present separately or jointly<sup>17</sup>: the effect of hosting elite sport events (which includes the infrastructure, demonstration, and festival effects), the effect of elite sport success, and the elite sport role modeling effect. These 3 effects refer to a process by which

people are inspired by elite sport events, success, or athletes to practice PA/sport themselves.<sup>18</sup> The trickle-down effect is mainly measured in the scientific literature by the PA level or the number (or the percentage) of individuals meeting a PA level or participating in a specific sport. To our knowledge, 7 literature reviews (4 systematic reviews,<sup>18–21</sup> 1 overview of systematic reviews,<sup>22</sup> 1 mapping review,<sup>23</sup> and 1 synthesis approach<sup>17</sup>) evaluated the potential benefit of elite sport on PA/sport practice in the general population. McCartney et al<sup>19</sup> showed neither health nor socioeconomic impact of hosting elite sport events; however, they did not focus solely on PA/sport. The 3 other systematic reviews<sup>18,20,21</sup> and the overview of systematic reviews<sup>22</sup> observed no evidence of an effect of hosting elite sport events on PA/sport practice in the general population. Only one systematic review also investigated the effect of elite sport success and showed no clear evidence of an effect in the general population.<sup>18</sup> The 3 aspects of the trickle-down effect of elite sport (hosting elite sport events, elite sport success, and elite sport role modeling effect) were only investigated in the mapping review<sup>23</sup> and the synthesis approach,<sup>17</sup> which concluded that the effects may occur only under specific circumstances. Because of the nature of these 2 nonsystematic reviews, the literature search and the quality evaluation were not accurate enough, and this may have biased their conclusions.

We wanted to supplement the current scientific literature reviews by investigating the effects of different types of intervention mechanisms of elite sport on PA/sport practice in the general population to provide new valuable insights for the decision makers, policymakers, and other stakeholders. Therefore, we conducted a systematic review evaluating the effects of different intervention mechanisms where elite sports support PA/sport participation in the general population.

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## Materials and Methods

### Systematic Review Protocol

The protocol of our systematic review was drafted by A.L., A.v.H., and A.V. in January 2021. The PRISMA guideline for reporting systematic reviews was used to design and report our systematic review (Figure 1). We did not register our systematic review in databases of prospectively registered systematic reviews (eg, PROSPERO).

### Data Sources and Searches

The following sources were searched: PubMed, JSTOR, Web of Science, SPORTDiscus, and PsycInfo. A Boolean search was conducted in the period from January 2000 to August 2021, among English peer-reviewed articles, using the following equation: (“elite” OR “high level” OR “performance”) OR [“Olympic\*” AND \* Games”] AND [“sport” OR “athletes” OR “players”] AND [“physical activit\*” OR “sport” OR “exercise”] AND [“participation” OR “practice”]. Manual searches were conducted using the reference lists from the recovered records.

### Study Selection/Inclusion Criteria

**Population.** We included studies focusing on the general population. Studies focusing on specific segments of the population (eg, young population) were included. Age range, territories, and types of PA/sport practice were considered as population characteristics in the analysis.

**Interventions.** The selected studies had to focus, entirely or partly, on the effect of elite sport on PA/sport practice in the general population. Interventions were defined as follows: hosting an elite sport event (eg, Olympic Games [OG]), success in elite sport (eg, medals at OG), and/or elite sport role modeling (eg, outstanding athletes or teams).<sup>15,16</sup> Elite sport is defined by national or international high performances; national, international, or professional status; and success in highly competitive leagues or international events.<sup>24</sup>

**Outcome Measures.** Studies were included if the level of PA/sport participation was reported, described as the percentage of the population reaching PA recommendations (or another PA practice cutoff), the amount (eg, min) of PA/sport practice, or the number of sport memberships. “Sport membership” referred to any organized sport participation, which has been identified as a contributing factor to meet PA recommendations.<sup>14,25,26</sup>

**Exclusion Criteria.** Studies not published in English were excluded. Books, book chapters, government and nongovernment reports, conference proceedings, and working papers were not included in the review due to the lack of a consistent peer-review process. Peer-reviewed articles that did not present original data/analysis were not included either. Therefore, study protocols, editorials, commentaries, consensus documents, guidelines, and literature reviews were not included unless they provided original data/analysis. Qualitative studies, which did not investigate a quantitative impact on population levels of PA/sport, were not considered. Studies focusing on perceptions or attitudes regarding

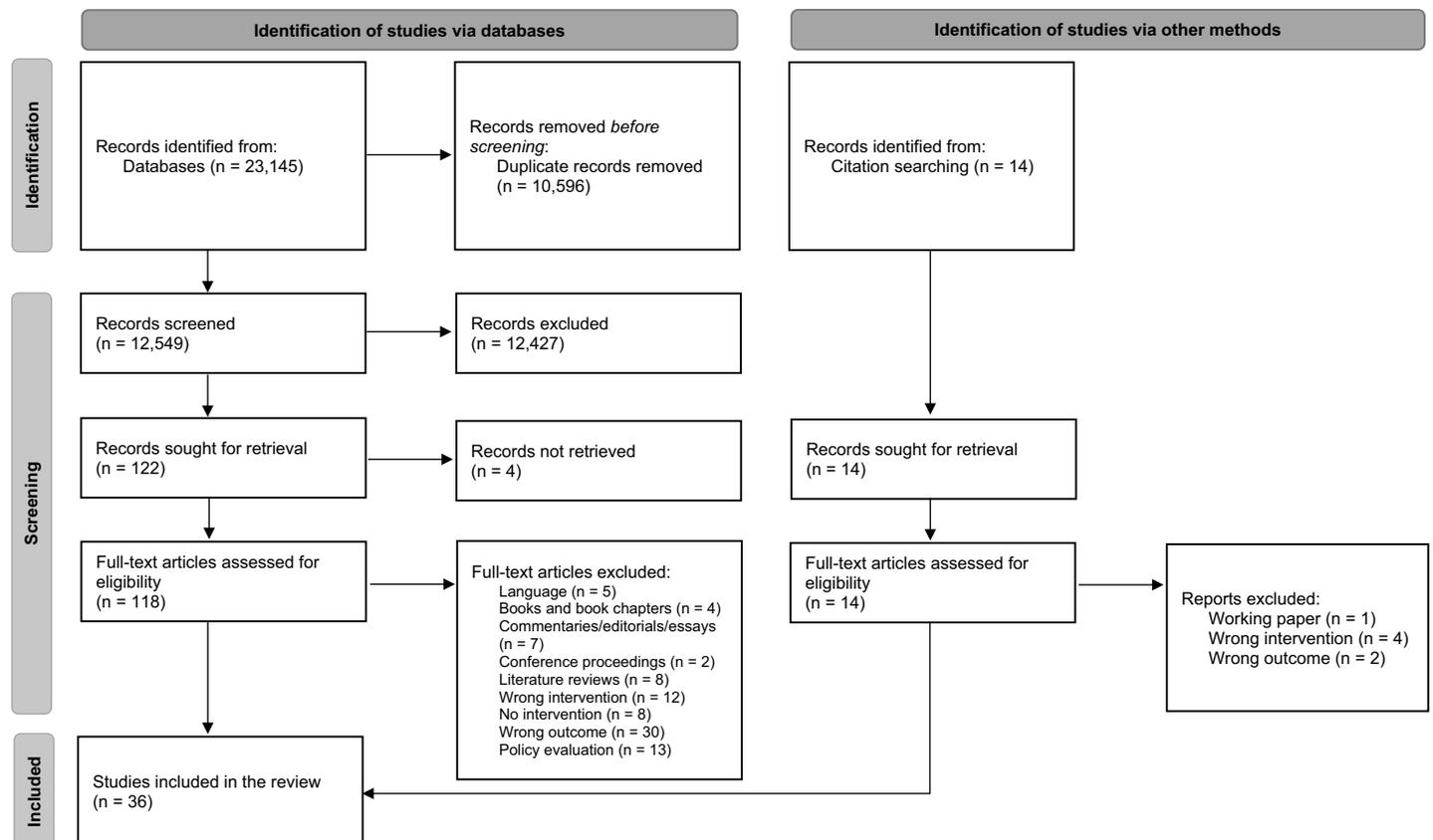


Figure 1 — PRISMA flow diagram.

PA/sport practice were not included. As the focus of our literature review was centered about the role of elite sport in general population PA/sport practice, elite sport events including mass participation (eg, city marathons) were considered as events for sports participation whether elite athletes participated or not. Moreover, the use of incentives for PA participation (eg, a voucher to participate in a PA offered at an elite event) was not considered as a leverage coming from elite sport. Therefore, the studies evaluating the 2 last effects were not included in our systematic review.

## Data Selection

Publications were retrieved from databases and imported in Covidence (Covidence systematic review software, Veritas Health Innovation), which automatically removed any duplicate records. Then, 2 authors (A.L. and A.v.H.) independently screened the titles and the abstracts using Covidence. Records were selected for a full-text read if the 2 authors agreed. A third author (A.V.) was available for mediation throughout this process. Full texts were selected by the first author (A.L.) and reviewed independently by 2 other authors (A.v.H. and F.L.).

## Data Extraction

The characteristics extracted from the records were the authors, the publication year, the countries from which the data were obtained, the aim of the study (or the aim of the analysis of interest in the article), the age range in youth and adult populations (the cutoff age of the youth/adult populations being set by the included studies) and the sample size of the population, the interventions (ie, hosting elite sport events, elite sport success, and/or elite sport role modeling), the outcomes, the design of the analysis, the survey/register vehicle, the period of interest, and the geographical level (local level: school, city, and regional levels; large-scale levels: national and international levels). For each record, the results in favor of the interventions or against the interventions were extracted. We extracted separately the immediate ( $\leq 1$  y) and lagged effects ( $>1$  y) of elite sport on PA/sport practice. The studies that did not specify the evaluation of a lagged effect were considered as studies evaluating an immediate effect. Data were extracted by the first author (A.L.) using Microsoft Excel. The extracted data were independently verified by 2 authors (A.v.H. and F.L.).

## Evaluation of the Quality of the Extracted Data and Their Analysis

The level of evidence, which is a ranking system used to describe the strength of the results in a research study, was evaluated based on the hierarchy of evidence<sup>27</sup> (see [Supplementary Material S1](#) [available online]). The hierarchy of evidence ranged from A for systematic review and meta-analysis studies, which are considered to provide the best evidence, to K for mixed-methods studies, which are considered to provide the poorest evidence. We modified the Downs and Black quality assessment tool<sup>28</sup> to evaluate the quality of the extracted data and their analysis (see [Supplementary Material S2](#) [available online]). The initial evaluation grid was designed for randomized and nonrandomized studies of health care interventions. We modified items and scoring to better fit the type of extracted data (which were often observational data in the selected studies) and their analysis. We withdrew several questions concerning the clinical studies, and we added questions concerning the control groups and

the effect size. Based on this modified version of the Downs and Black quality assessment tool, the quality of the extracted data and their analysis was rated as poor, fair, good, or excellent. The level of evidence and the quality of the extracted data and the analysis of each study were independently evaluated by 2 reviewers each.

## Results

### Search Results and Flow of Records Through the Systematic Review

A total of 12,549 records (excluding duplicates) were identified. Following title and abstract screening, the full-text versions of 122 articles were searched, and 118 articles were retrieved (ie, 4 records were not retrieved). Following the full-text screening, 29 articles were considered eligible for inclusion.<sup>29–57</sup> Fourteen articles were identified from the reference lists of the former articles, of which 7 were eligible for inclusion.<sup>58–64</sup> Therefore, 36 articles were included in our systematic review (Figure 1). Besides the 4 records that were not retrieved, 96 articles were excluded after the full-text screening (Figure 1): 5 records were not published in English (despite an English title); 4 records were books or book chapters; 7 records were commentaries, editorials, or essays; 2 records were conference proceedings; 8 records were literature reviews; 1 record was a working paper; 8 records had no intervention; 13 records were policy evaluations; 16 records had wrong interventions; and 32 records had wrong outcomes. The full list of excluded references can be found in the [Supplementary Material S3](#) (available online).

### Characteristics of the Included Records

The characteristics of the included records are presented in Table 1. Most records used data from the United Kingdom ( $n = 10$ ), followed by Australia ( $n = 5$ ), Canada ( $n = 4$ ), and multiple countries (studies using data from several countries) ( $n = 4$ ). The possible effect of elite sport was investigated at an international level in 3 articles, at a national level in 27 articles, at a regional level in 11 articles, at a municipal level in 6 articles, and at a school level in one article (11 studies investigated more than one level). Most records investigated the effect of hosting elite sport events ( $n = 27$ ), followed by elite sport success ( $n = 16$ ) and elite sport role modeling ( $n = 3$ ). Among these, 3 studies evaluated the effect of hosting an elite sport event, elite sport success, and elite sport role modeling, and 4 evaluated the effect of hosting elite sport events and elite sport success. PA/sport practice was the primary outcome of 28 studies and was a secondary outcome in the remaining studies. PA/sport practice was evaluated by questionnaires/surveys in 22 studies, collected in registries (ie, for membership) in 11 studies, measured by both methods in one study, and evaluated by questionnaires/surveys and recorded with pedometers in 2 studies. Thirteen studies evaluated the effect of elite sport on adults only, 6 on youth populations only, and 9 on both, and age ranges were not indicated in the 8 remaining studies. However, 2 studies, which did not indicate the age range, used data from the Active People Surveys, which are known from other included studies to contain data from people aged over 16 years.

### Evaluation of the Quality of the Extracted Data and Their Analyses

One study was a cohort study; 24 were time series, trends, or panel studies; 6 were cross-sectional studies; and the remaining 5 studies used lower levels of evidence (Tables 1 and 2, see [Supplementary](#)

**Table 1 Characteristics of the Included Studies Evaluating the Effect of Hosting Elite Sport Events (🏆), Elite Sport Success (🏆), and/or Elite Sport Role Modeling (★) on PA or Sport Participation or Membership**

<b>Authors 📍 Data's country</b>	<b>Aim of the study/analyses</b>	<b>Age range Sample size</b>	<b>Interventions</b>	<b>① Main or ② secondary outcomes of the study</b>	<b>📊 Study design 📄 Survey/register vehicle 📅 Period of interest 📍 Geographical level</b>
Lines (2007) <sup>29</sup>	To examine the impact of selected sports media events on the PA/sport participation of a group of young people aged 14/15	Youth, 14–15 y N = 25	🏆 The 1996 UEFA European Football Championship, the 1996 Wimbledon Lawn Tennis Championships, Atlanta 1996 OG	① PA diary log during event period	📄 Case study 📄 Convenience samples 📅 1996 📍 Regional level
United Kingdom					
Hanstad and Skille (2010) <sup>58</sup>	To examine the relationship between elite and mass biathlon practices in Norway	n/a N = n/a	🏆 Medals at OG and World Championship, and top 15 World Cup places	① Participation in a mass biathlon race, biathlon club memberships	📄 Time series study 📄 Norwegian Biathlon Association 📅 1994–2004 📍 National level
Norway					
Frawley and Cush (2011) <sup>59</sup>	To examine the impact of major sport events hosting on PA/sport participation	Youth, <18 y Adults, ≥18 y N = n/a	🏆 The 2003 Rugby World Cup	① Rugby Union memberships	📄 Time series study 📄 Australian Rugby Union 📅 2000, 2008 📍 National/regional levels
Australia					
Veal et al (2012) <sup>60</sup>	To examine whether any significant increases in PA/sport participation had occurred following elite sport events in Australia	Youth, 5–14 y N = 33,100 Adults, ≥15 y N = 147,900	🏆 Sydney 2000 OG, the 2003 Rugby World Cup, the 2006 Melbourne Commonwealth Games	① Different PA participation data	📄 Review of documents 📄 17 Australian surveys 📅 1997–2019 📍 National/regional levels
Australia					
de Bosscher et al (2013) <sup>61</sup>	To examine the relationship between international sporting success and membership figures in 20 sports	n/a N = n/a	🏆 Elite sport index based on top 8 successes at European and World Championships, OG, or other important events	① Memberships for 20 sports	📄 Time series study 📄 Flemish Sport Administration Agency 📅 1992–2010 📍 Regional level
Belgium					
Feng and Hong (2013) <sup>62</sup>	To examine whether the Beijing 2008 OG had a long-term impact on grassroots PA/sport participation in townships in China	Adults N = 140	🏆 Beijing 2008 OG	① Frequencies of current and retrospective PA levels	📄 Cross-sectional study 📄 Convenience samples in Chinese townships 📅 2010, 2011 📍 Municipal level
China					
Wicker and Sotiriadou (2013) <sup>63</sup>	To examine the effect of the 2006 Melbourne Commonwealth Games on PA/sport participation	Adults, ≥15 y N = 12,993	🏆 The 2006 Melbourne Commonwealth Games	① More PA time (yes/no), new engagement in PA practice (yes/no)	📄 Time series study 📄 Exercise Recreation and Sport Surveys 📅 2005, 2006 📍 National/regional levels
Australia					
Craig and Bauman (2014) <sup>30</sup>	To examine whether hosting the Vancouver 2010 OG further increased PA/sport participation from initial relatively high levels among children in Canada and especially British Columbia	Youth, 5–19 y N = 19,682	🏆 Vancouver 2010 OG	① Steps per day (pedometers), organized PA/sport participation (yes/no, based on parents' answers)	📄 Time series study 📄 Canadian Physical Activity Levels Among Youth study 📅 2007–2011 📍 National/regional levels
Canada					

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Table 1 (continued)

Authors Data's country	Aim of the study/analyses	Age range Sample size	Interventions	Main or secondary outcomes of the study	Study design Survey/register vehicle Period of interest Geographical level
Ruseski and Maresova (2014) <sup>64</sup> Multiple countries	To examine the effect of different variables, including elite sport success and hosting, on PA/sport participation	Adults, ≥15 y N = 49,730	Number of elite sport events (eg, OG, FIFA World Cup, UEFA European Football Championships, Commonwealth Games, Pan American Games, Rugby World Cup, FIBA World Championship for basketball, and the Cricket World Cup) Medals/athletes at Athens 2004 OG Sydney 2000 OG	PA participation (1 if daily PA or PA several times per week, 0 if PA several times per month or never)	Cross-sectional study International Social Survey Programme Leisure Time and Sports module 2006–2008 International level
Bauman et al (2015) <sup>41</sup> Australia	To examine the immediate effects of the Sydney 2000 OG on adult PA participation using data collected a year before and 6 wk after the OG	Adults, 18–75 y N = 7423	Sydney 2000 OG	Walking minutes, moderate PA minutes, vigorous PA minutes, number of PA sessions in the past week based on 6 questions	Time series study National PA surveys 1999, 2000 National/regional levels
Frawley and Van den Hoven (2015) <sup>51</sup> Australia	To examine the impact of qualification for the 2006 FIFA World Cup on football participation in Australia	Youth, 5–14 y N ≈ 8000 <sup>a</sup> Adults, ≥15 y N ≈ 10,000 <sup>a</sup>	Qualification of the Australian team to the 2006 FIFA World Cup	Number of extracurricular football participation, number of football participation in the past 12 mo	Time series study Australian Bureau of Statistics, Exercise Recreation and Sport Surveys 2003–2009 National level
Goranova and Byers (2015) <sup>32</sup> United Kingdom	To examine the relationship between sport funding, sport success, and PA/sport participation	n/a N = n/a	Medals at Beijing 2008 OG and London 2012 OG	Number and percentage of PA participation (at least 30 min) in the last 4 wk in 29 sports	Time series study Active People Surveys 2006–2012 National level
Moscoso-Sánchez et al (2015) <sup>53</sup> Spain	To examine whether the image of Spain, as a country of great sporting idols, influences sports practice in the general population	n/a N = 8925	Spanish sport success	Percentage of PA participation and sports memberships	Time series study Survey of Sport Habits; National Census of Sporting Facilities 1975–2010 National level
Perks (2015) <sup>54</sup> Canada	To examine the effect of the Vancouver 2010 OG on PA/sport participation in Canada	Adults, ≥15 y N = 34,987	Vancouver 2010 OG	Number and percentage of PA participation in the last 24 h (based on a time use diary)	Time series study General Social Surveys on Time-Use 2005, 2010 National/regional/municipal levels
Weimar et al (2015) <sup>55</sup> Germany	To examine the impact of elite sport on membership figures in German sport clubs	Youth, <19 y N = 190,886 <sup>b</sup> Adults, ≥19 y N = 408,776 <sup>b</sup>	OG, World or European championships, and so forth Gold medals or victory at important elite sport events Top 3 at the selection of the athlete and team of the year London 2012 OG	Memberships for 12 Olympic sports	Time series study German Olympic Sports Confederation 1970–2011 National level
Downward et al (2016) <sup>56</sup> United Kingdom	To examine the relationship between PA/sport participation and subjective health accounting for the London 2012 OG	Adults, ≥16 y N ≈ 14,000 <sup>a</sup>	London 2012 OG	Minutes of PA participation in the last 4 wk in 68 sports	Time series study Taking Part Surveys 2005–2013 National level

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Table 1 (continued)

Authors Data's country	Aim of the study/analyses	Age range Sample size	Interventions	Main or secondary outcomes of the study	Study design Survey/register vehicle Period of interest Geographical level
Frick and Wicker (2016) <sup>57</sup> Germany	To examine the effect of sporting success on amateur participation in German football	n/a N = n/a	Male and female World and European football titles	① Football memberships (and number of clubs and teams)	Time series study German Football Association 1950–2014 National level
Kohe and Bowen-Jones (2016) <sup>31</sup> United Kingdom	To examine perceptions and experiences of the London 2012 OG and physical education and PA in students from London and a Midlands city	Youth, 11–13 y N = 348	London 2012 OG	② Curricular and extracurricular PA participation (based on a Likert scale to evaluate the frequency)	Cross-sectional study Convenience samples in London and a Midlands city 2012 School level
Pappous and Hayday (2016) <sup>52</sup> United Kingdom	To examine the effect of the London 2012 OG on participation percentage in judo and fencing	Youth and adults N = 16,695 <sup>b</sup>	London 2012 OG	① Judo and fencing memberships	Time series study Judo and fencing national federation 2007–2013 National level
Potwarka and Leatherdale (2016) <sup>33</sup> Canada	To examine the effect of the Vancouver 2010 OG on the leisure-time PA rates among male and female youth in Canada	Youth, 12–19 y N = 3,086,018	Vancouver 2010 OG	① Number of PA participation within active, moderately active, or inactive categories (based on nature, frequency, and duration of leisure-time PA)	Time series study Canadian Community Health Survey 2007/2008, 2009/2010, 2011/2012 National/regional levels
Grix et al (2017) <sup>34</sup> United Kingdom	To examine the legacy of sport mega-events, especially on PA/sport participation	n/a N = n/a	London 2012 OG	② Different PA participation data	National/regional levels Scientific statement Active People Surveys 2005/2006, 2014/2015 National/municipal levels
Kaplanidou (2017) <sup>35</sup> Multiple countries	To examine health-related attitudes and behaviors among various OG host cities' residents	Adults N = 799	Atlanta 1996 OG, Sydney 2000 OG, Athens 2004 OG, Beijing 2008 OG	② More PA (yes/no), more participation in sport events as an athlete (yes/no)	Cross-sectional study Convenience samples of residents of Atlanta, Sydney, Athens, and Beijing 2010 Municipal level
Aizawa et al (2018) <sup>36</sup> Japan	To examine whether the shared experience of the Tokyo 1964 OG during youth would explain subsequent PA/sport participation later in life	Adults, ≥20 y N = 5815	OG and World Athletics Championships in Japan Medals won at the Tokyo 1964 OG per region	① Number of instances of PA/sport participation per year (based on one retrospective question)	Cohort study Japanese National Sport-Life Survey 1994, 2004, 2014 National/regional levels
Haut and Gaum (2018) <sup>37</sup> Multiple countries	To examine the effect of table tennis success and events hosting on long-term membership figures in 3 different countries	n/a N = n/a	European, Team World, and World Championships Elite sport index based on top 4 successes at European and World Championships and OG	① Table tennis memberships	Time series study Austrian, French, and German national federations 1964–2014 International/national levels

(continued)

Table 1 (continued)

Authors Data's country	Aim of the study/analyses	Age range Sample size	Interventions	Main or secondary outcomes of the study	Study design Survey/register vehicle Period of interest Geographical level
Storm et al (2018) <sup>38</sup> Denmark	To examine whether handball success influenced amateur participation in Denmark	Youth and adults N = n/a	Handball tournaments Index based on top 8 successes in the World or European Championships or OG ★ Outstanding members of the Danish handball national teams	① Handball memberships	Time series study Danish Handball Federation 1964–2016 National level
Ishigami (2018) <sup>39</sup> Japan	To examine the effect of the victory of the Japanese national team at the 2011 FIFA Women's World Cup on PA/sport participation among Japanese female students	Youth, 13–15 y N ≈ 1.7 million	2011 FIFA Women's World Cup Champion and second place at the London 2012 OG	① Number of instances of extracurricular football participation	Time series study Nippon Junior High School Physical Culture Association 2003–2015 National level
Kokolakakis et al (2018) <sup>40</sup> United Kingdom	To examine the 2-y effect of the London 2012 OG on adult PA/sports participation	Adults, ≥16 y N ≈ 165,000 <sup>a</sup>	London 2012 OG	① Number of respondents participating in PA at least once, 4 times, or 12 times (for at least 30 min each time) in the last 4 wk ② Percentage of active adults	Time series study Active People Surveys 2005–2014 National level Review of documents Active People Surveys 2007/2008, 2011/2012, 2015/2016 National level
Milton et al (2019) <sup>42</sup> United Kingdom	To examine developments in sport and health policy in England since the announcement of the London 2012 OG	Adults, ≥16 y N = n/a	London 2012 OG	① Number of respondents participating in PA at least once, 4 times, or 12 times (for at least 30 min each time) in the last 4 wk in 43 sports	Time series study Active People Surveys 2005–2014 National level
Kokolakakis and Lera-Lopez (2020) <sup>43</sup> United Kingdom	To examine the effect of the London 2012 OG on adult PA/sports participation	Adults, ≥16 y N ≈ 165,000 <sup>a</sup>	London 2012 OG	① Percentage of the population participating in any form of PA/sport over the past year	Time series study Cross-sectional biannual leisure-time survey among citizens of Rotterdam 1995–2017 Municipal level
Möhlenberg et al (2020) <sup>44</sup> The Netherlands	To examine the effect of hosting elite sport events on PA/sport participation	Adults, 18–75 y N = 27,235	10 elite sport events in Rotterdam	① Memberships for 23 sports	Time series study Supreme Council for Sports 1992–2016 National level
Segui-Urbeja et al (2020) <sup>45</sup> Spain	To examine the relationship between elite sport success and mass participation in sport	n/a N = 75,000 <sup>b</sup>	Elite sport index based on medals at World Championships and OG	① Metabolic equivalent of task by minutes/week based on the International Physical Activity Questionnaire—Short Form	Time series study Cross-sectional study Study's PA survey 2019 Municipal level
Annear et al (2021) <sup>47</sup> Japan	To examine PA parameters among urban, middle-aged, and older Japanese during the build-up to hosting the Tokyo 2020 OG	Adults, ≥45 y N = 4000	Tokyo 2020 OG	② Steps per day (pedometers), percentage of the population participating in PA/sport	Time series study PA surveys 1988–2021 International level
Bauman et al (2021) <sup>48</sup> Multiple countries	To examine the temporal trends in PA and sports participation in countries that hosted OG since 1996	Youth and adults N = n/a	OG since 1996		

(continued)

Table 1 (continued)

Authors Data's country	Aim of the study/analyses	Age range Sample size	Interventions	Main or secondary outcomes of the study	Study design Survey/register vehicle Period of interest Geographical level
Castellanos-Garcia et al (2021) <sup>49</sup> United Kingdom	To examine the relationship between sport club membership and sporting success in England using a dynamic panel data approach	Youth, <18 y Adults, ≥18 y N ≈ n/a	<ul style="list-style-type: none"> <li>🏆 European or World championship or OG in the United Kingdom</li> <li>🏆 Gold medals won at the OG, World or European Championships, or an equivalent event</li> <li>★ Top 3 at the selection of the athlete or team of the year</li> </ul>	<ul style="list-style-type: none"> <li>① Memberships for 33 sports</li> </ul>	<ul style="list-style-type: none"> <li>🏠 Panel study</li> <li>📄 Active People Surveys 2005–2016</li> <li>🌐 National level</li> </ul>
Potwarka et al (2021) <sup>50</sup> Canada	To examine the effect on youth PA in the hometowns of Canadian athletes who competed at the London 2012 OG	Youth, 12–19 y N = 3,086,068	<ul style="list-style-type: none"> <li>🏆 Vancouver 2010 OG</li> <li>🏆 Participation and medals of Canadian athletes at London 2012 OG</li> </ul>	<ul style="list-style-type: none"> <li>① Percentage of respondents participating (active and moderately active levels) in leisure-time PA based on frequency, duration, and PA type in the past 3 mo</li> </ul>	<ul style="list-style-type: none"> <li>🏠 Time series study</li> <li>📄 Canadian Community Health Survey 2009/2010, 2011/2012, 2013/2014</li> <li>🌐 National/regional levels</li> </ul>
Storm and Holm (2021) <sup>46</sup> Denmark	To examine the impact of professional soccer clubs on local membership figures in Danish municipalities	Youth, 7–15 y Adults, ≥15 y N = n/a	<ul style="list-style-type: none"> <li>🏆 Ranking of the football teams in the 2 best Danish male tiers</li> </ul>	<ul style="list-style-type: none"> <li>① Football memberships (per 1000 inhabitants)</li> </ul>	<ul style="list-style-type: none"> <li>🏠 Time series study</li> <li>📄 Sports Confederation of Denmark 2007–2017</li> <li>🌐 National level</li> </ul>

Abbreviations: n/a, not available; OG, Olympic Games; PA, physical activity; FIFA, Fédération Internationale de Football Association; FIBA, Fédération Internationale de Basketball; UEFA, Union of European Football Associations.

<sup>a</sup>For each survey wave. <sup>b</sup>Average of memberships per year and PA throughout the studied period.

**Table 2 Level of Evidence (From A to K, A Being the Highest Level of Evidence), Quality Score (From Poor to Excellent, Based on a Modified Version of the Downs and Black Quality Assessment Tool) of the Extracted Data and Their Analysis, and Immediate ( $\leq 1$  y) or Lagged Effect and Local (School, City, or Regional Levels) or Large-Scale Effect of Hosting Elite Sport Events (Part A), Elite Sport Success (Part B), or Elite Sport Role Modeling (Part C) on PA/Sport Participation or Membership for Youth and Adult Populations**

Authors	Level of evidence	Quality score	Effect in youth population	Lagged effect in youth population	Effect in adult population	Lagged effect in adult population	Local effect	Large-scale effect
A. Effect of hosting elite sport events								
Lines <sup>29</sup>	G	Poor	↓0↑	NI	NI	NI	NI	NI
Frawley and Cush <sup>59</sup>	D	Fair	↑	↑	↑	↓0↑	↓0↑	↓0↑
Veal et al <sup>60</sup>	I	Poor	↓0↑	↓0↑	↓0↑	↓0↑	↓0↑	0
Feng and Hong <sup>62</sup>	F	Poor	NI	0	NI	0	NI	NI
Wicker and Sotiriadou <sup>63</sup>	F	Fair	NI	NI	↑	NI	0	0
Craig and Bauman <sup>30</sup>	D	Fair	0	NI	NI	NI	0	0
Ruseski and Maresova <sup>64</sup>	F	Good	NI	NI	↑	NI	NI	NI
Bauman et al <sup>41</sup>	D	Good	NI	NI	↓0↑	NI	↑	0
Perks <sup>54</sup>	D	Fair	NI	NI	↓	NI	↓0↑	↓
Weimar et al <sup>55</sup>	D	Excellent	↑	0	↑	0	NI	NI
Downward et al <sup>56</sup>	D	Fair	NI	NI	0	NI	NI	NI
Kohe and Bowen-Jones <sup>31</sup>	F	Fair	↓0↑	NI	NI	↓0↑	NI	NI
Pappous and Hayday <sup>32</sup>	D	Fair	NI	NI	0	NI	NI	NI
Potwarka and Leatherdale <sup>33</sup>	D	Fair	↓0↑	NI	NI	NI	↓0↑	0
Grix et al <sup>34</sup>	J	Poor	NI	NI	↓0↑	↓0↑	↓0↑	NI
Kaplanidou <sup>35</sup>	F	Poor	NI	NI	NI	↓0↑	↓0↑	NI
Aizawa et al <sup>36</sup>	C	Good	NI	NI	NI	↓0↑	0	NI
Haut and Gaum <sup>37</sup>	D	Good	0 <sup>a</sup>	NI	0 <sup>a</sup>	NI	NI	NI
Storm et al <sup>38</sup>	D	Good	0	NI	0	NI	NI	NI
Kokolakakis et al <sup>40</sup>	D	Good	NI	NI	↑	↑	NI	NI
Milton et al <sup>42</sup>	I	Poor	NI	NI	0	0	NI	NI
Kokolakakis and Lera-Lopez <sup>43</sup>	D	Good	NI	NI	↑	↑	NI	NI
Mötenberg et al <sup>44</sup>	D	Good	NI	NI	↓0↑	↓0↑	NI	NI
Annear et al <sup>47</sup>	F	Good	NI	NI	NI	↑	↓0↑	NI
Bauman et al <sup>48</sup>	D	Poor	NI	NI	↓0↑	↓0↑	NI	↓0↑
Castellanos-Garcia et al <sup>49</sup>	D	Fair	↑	NI	0	↓0↑	NI	NI
Potwarka et al <sup>50</sup>	D	Fair	0	NI	NI	NI	0	0
B. Effect of elite sport success								
Hanstad and Skille <sup>58</sup>	D	Poor	↑ <sup>a</sup>	↑ <sup>a</sup>	↑ <sup>a</sup>	NI	NI	NI

(continued)

**Table 2 (continued)**

Authors	Level of evidence	Quality score	Effect in youth population	Lagged effect in youth population	Effect in adult population	Lagged effect in adult population	Local effect	Large-scale effect
de Bosscher et al <sup>61</sup>	D	Fair	↓0↑ <sup>a</sup>	↓0↑ <sup>a</sup>	↓0↑ <sup>a</sup>	↓0↑ <sup>a</sup>	NI	NI
Ruseski and Maresova <sup>64</sup>	F	Good	NI	NI	NI	↓	NI	NI
Frawley and Van den Hoven <sup>51</sup>	D	Poor	↓0↑	NI	↑	↑	NI	NI
Goranova and Byers <sup>52</sup>	D	Poor	NI	NI	↑	NI	NI	NI
Moscoso-Sánchez et al <sup>53</sup>	K	Poor	↓0↑ <sup>a</sup>	NI	↓0↑ <sup>a</sup>	NI	NI	NI
Weimar et al <sup>55</sup>	D	Excellent	0	↓0↑	0	↓0↑	NI	NI
Frick and Wicker <sup>57</sup>	D	Good	NI	↓0↑ <sup>a</sup>	NI	↓0↑ <sup>a</sup>	NI	NI
Aizawa et al <sup>36</sup>	C	Good	NI	NI	NI	0	NI	NI
Haut and Gaum <sup>37</sup>	D	Good	0 <sup>a</sup>	↑ <sup>a</sup>	0 <sup>a</sup>	↑ <sup>a</sup>	NI	↓0↑ <sup>a</sup>
Storm et al <sup>38</sup>	D	Good	NI	↓0↑	NI	0	NI	NI
Ishigami <sup>39</sup>	D	Good	0	0	NI	NI	NI	NI
Seguí-Urbaneja et al <sup>45</sup>	D	Fair	↓0↑ <sup>a</sup>	NI	↓0↑ <sup>a</sup>	NI	NI	NI
Castellanos-García et al <sup>49</sup>	D	Fair	0	0	0	↓0↑	NI	NI
Potwarka et al <sup>50</sup>	D	Fair	↓0↑	NI	NI	NI	↓0↑	NI
Storm and Holm <sup>46</sup>	D	Good	0	↓0↑	0	0	NI	NI
C. Effect of elite sport role modeling								
Weimar et al <sup>55</sup>	D	Excellent	0	↓0↑	0	0	NI	NI
Storm et al <sup>38</sup>	D	Good	0	NI	0	NI	NI	NI
Castellanos-García et al <sup>49</sup>	D	Fair	0	0	0	↓0↑	NI	NI

Abbreviation: PA, physical activity; NI, not investigated. Note: The studies that did not specify the evaluation of a lagged effect (>1 y) were considered as studies evaluating an immediate effect (≤1 y). ↑: Positive effect on PA/sport participation or memberships; ↓: negative effect on PA/sport participation or memberships; 0: null effect on PA/sport participation or memberships; ↓0↑: mixed effect on PA/sport participation or memberships (mixed effect refers to negative, null, and/or positive effects on PA/sport participation or memberships within a specific segment of the population in a given study).

<sup>a</sup>The studies did not provide the age range of the studied population.

**Material S1** [available online]). The quality evaluation showed that the reliability of extracted data was rated poor or fair in 23 studies out of 36 (see **Supplementary Material S4** [available online]). The extracted data were reliable (rated as good or excellent) in just over one third of the studies (10 out of 27 studies) evaluating the effect of hosting elite sport events, in half of the studies (8 out of 16 studies) evaluating the effect of elite sport success, and in 2 out of 3 studies evaluating the effect of elite sport role modeling (Table 2). The major issues in the extracted data and their analysis were the lack of comparators (ie, counterfactuals in time series studies), the reliability of the outcomes (ie, questionnaires to evaluate the PA/sport practice), limited statistical analyses, and the absence of discussion of effect sizes.

### Effect of Hosting Elite Sport Events on PA/Sport Practice in the General Population

The studies evaluating the effect of hosting elite sport events are presented in Table 2A and **Supplementary Material S5** (available online). The effects were evaluated using data from the United Kingdom (n = 9), Australia (n = 4), and multiple countries (n = 4). Hosting the OG was evaluated in 22 studies, and hosting other elite sport events (such as the Commonwealth Games and World Championships) was evaluated in 11 studies.

Null or mixed effects (mixed effects included negative, null, or positive effects observed within the same study) of hosting elite events on youth populations were observed in 3<sup>30,38,50</sup> and 4<sup>29,31,33,60</sup> studies, respectively. Three studies observed an increase in PA/sport practice after hosting elite sport events.<sup>49,55,59</sup> Null<sup>55</sup> or mixed<sup>60</sup> lagged effects were observed in one study each, respectively; one study observed a lagged increase in PA/sport participation after hosting elite sport events.<sup>59</sup>

Negative, null, or mixed effects of hosting elite sport events in adult populations were observed in 1,<sup>54</sup> 6,<sup>32,38,42,49,56,62</sup> and 5<sup>34,41,44,48,60</sup> studies, respectively. Six studies observed an increase in PA/sport practice after hosting elite sport events.<sup>40,43,55,59,63,64</sup> Null or mixed lagged effects were observed in 3<sup>42,55,59</sup> and 7<sup>34–36,44,48,49,60</sup> studies, respectively; 3 studies observed a lagged increase in PA/sport participation after hosting elite sport events.<sup>40,43,47</sup>

One study, which did not provide the age range of the studied population, observed a null effect of hosting elite sport events on sport memberships.<sup>37</sup>

Negative, null, or mixed effects of hosting elite sport events on PA/sport practice at a large-scale level were observed in 1,<sup>54</sup> 6,<sup>30,33,41,50,60,63</sup> and 2 studies,<sup>48,59</sup> respectively. Null or mixed effects of hosting elite sport events on PA/sport practice at local levels were observed in 5<sup>30,36,50,62,63</sup> and 8 studies,<sup>31,33–35,47,54,59,60</sup> respectively; one study observed a positive effect of hosting elite sport events at local levels.<sup>41</sup>

### Effect of Elite Sport Success on PA/Sport Practice in the General Population

The studies evaluating the effect of elite sport success are presented in Table 2B and **Supplementary Material S5** (available online). The effect was investigated using data from Denmark, Germany, Spain, the United Kingdom, Japan, and multiple countries (study using data from several countries) in 2 records each and from Australia, Belgium, Canada, and Norway in one record each (Table 1). Elite sport success was evaluated using the number of medals or titles won at elite sport events, the (modified) elite sport index (based on

finalist or semifinalist places at elite sport events), or rankings in championships.

Null or mixed effects of elite sport success on PA/sport practice in youth population were observed in 4<sup>39,46,49,55</sup> and 2<sup>50,51</sup> studies, respectively. Null or mixed lagged effects of elite sport success on PA/sport practice in youth population were observed in 2<sup>39,49</sup> and 3<sup>38,46,55</sup> studies, respectively.

Null effect of elite sport success on PA/sport practice in adult populations was observed in 3 studies.<sup>46,49,55</sup> Two studies observed an increase in PA/sport practice in adult populations after elite sport success.<sup>51,52</sup> Negative, null, or mixed lagged effects of elite sport success on PA/sport practice in adult populations were observed in 1,<sup>64</sup> 3,<sup>36,38,46</sup> and 2 studies,<sup>49,55</sup> respectively. One study observed a lagged increase in PA/sport practice in adult populations after elite sport success.<sup>51</sup>

The 6 studies that did not provide the age range of the studied population showed diverse results. Null or mixed effects of elite sport success on PA/sport practice were observed in 1<sup>37</sup> and 3 studies,<sup>45,53,61</sup> respectively; one study observed an increase in PA/sport practice after elite sport success.<sup>58</sup> Two studies observed mixed lagged effects of elite sport success on PA/sport practice<sup>57,61</sup>; one study observed a lagged increase in PA/sport practice after elite sport success.<sup>37</sup>

The effect of elite sport success on PA/sport practice was investigated at local<sup>50</sup> and large-scale<sup>37</sup> levels in one study each, with mixed effects.

### Effect of Elite Sport Role Modeling on PA/Sport Practice in the General Population

Three studies focused on elite sport role modeling (Table 2C and **Supplementary Material S5** [available online]). These studies used data from the United Kingdom, Denmark, and Germany. Two studies used the classification of athletes at the selection of the athlete/team of the year, broadcast on TV. One study used word of mouth to select outstanding athletes of the year from the Danish handball team. No evidence of an immediate or lagged elite sport role modeling effect was observed.<sup>38,49,55</sup>

## Discussion

### Effect of Hosting Elite Sport Events on PA/Sport Practice in the General Population

Most of the studies included in our systematic review observed null or mixed effects of hosting elite sport events. The lagged effect of hosting elite sport events was inconclusive. In addition, we performed a multivariate analysis, presented in the **Supplementary Material S6** (available online), to investigate whether our results were driven by the design and characteristics of the studies. The multivariate analysis indicated that the likelihood of observing a positive impact of hosting an elite sport event on PA/sport practice was statistically related to the quality (good/excellent) of the extracted data; the other characteristics of the studies (publication year, geographical level, population, intervention, and types of outcomes) were not significant.

Beyond the statistical exercise, it is interesting to focus on studies that evaluated a common event to understand the differences in findings. For example, the legacy of the London 2012 OG was evaluated in ten articles, 7 of which used the same databases (ie, the Active People Surveys). These studies showed inconsistent results. An increase of 700,000 people participating in sport or PA

once per week was observed in England after the London 2012 OG.<sup>40,42,43</sup> But, as pointed out by Milton et al,<sup>42</sup> the proportion of the population participating in sport or PA once per week remained stable (36.6% in 2007/2008, 36.9% in 2011/2012, and 36.1% in 2015–2016), because the total population of England also increased. Therefore, it is essential to consider the relative proportion of the active population rather than the absolute number. Bauman et al<sup>48</sup> studied the effect of hosting the OGs on the proportion of PA participation in the host cities/nations and concluded that OG had not improved population-wide PA. In addition, level of income, demographic structure, or cultural heritage could also explain the relationship between PA/sport practice and elite sport event hosting.<sup>64</sup> The lack of evidence of the immediate and lagged effects of hosting elite sport events on PA/sport practice in the general population may have the same underlying causes, which could be, however, explained by different geographic considerations. On a large-scale level, these events were often not associated with specific mass communications on enjoyable daily movement that could have stimulated regular PA/sport in the general population instead of focusing on elite sport heroes.<sup>48,65</sup> Furthermore, the facilities where elite sport events were organized are often not accessible for local people to practice PA/sport and are even sometimes abandoned or dismantled.

### Effect of Elite Sport Success on PA/Sport Practice in the General Population

Most of the studies included in our systematic review observed null or mixed effects of elite sport success. The possible lagged effect of elite sport success was erratic, with increases or decreases occurring randomly up to 10 years after the success. In addition, the multivariate analysis (see [Supplementary Material S6](#) [available online]) indicated that the likelihood of observing a positive impact of elite sport success on PA/sport practice was statistically inversely related to the quality (good/excellent) of the extracted data; the other characteristics of the studies were not significant.

Beyond the statistical exercise, it is interesting to focus on studies that evaluated similar elite sport successes to understand the differences in findings. Three studies indicated a positive effect of FIFA World Cup titles or qualification on football club memberships.<sup>39,51,57</sup> However, it is not clear whether this increase would have also occurred without those successes.<sup>39</sup> Often, the studies did not compare participation in football with that in other types of sports to control for a possible secular trend in PA/sport participation. Haut et al<sup>37</sup> suggested considering elite sport success as a currency with a value that varies between countries and may be affected by inflation. The ability of elite sport success to increase PA/sport may depend on the success habits and the current situation of PA/sport participation in a sport in a given country. The effect of success may be greatest after the first victory but may tend to decrease as a country becomes accustomed to success. Unfortunately, the cumulative effect of successes is rarely directly investigated.

### Effect of Elite Sport Role Modeling on PA/Sport Practice in the General Population

The role model effect was investigated in only 3 studies, and in general, a null effect was observed. Therefore, there is no evidence to support an elite sport role modeling effect in increasing PA/sport participation in the general population. Moreover, the effect of negative behaviors (doping, cheating, or other scandals) is still unknown.

## Quality of the Extracted Data and Study Design

The possible effect of elite sport was investigated in only a few countries (mostly the United Kingdom, Australia, and Canada), and the results may not be representative of all countries. The quality of most of the extracted data was poor or fair. Therefore, the reliability of the results is limited. The PA levels were mainly evaluated with questions that were not scientifically validated. For instance, the main outcome used by Aizawa et al<sup>36</sup> was the annual frequency of sport participation, which was assessed using the following question: “How many times did you participate in sports in the previous year?” (an option was, however, set to provide the average frequency of participation per month or week as an alternative). Only 2 studies used PA data that were measured using pedometers. In addition, in several studies, it was not possible to determine whether participants increased their PA levels or changed their PA/sport practice or if the number of participants increased. For the studies that used data from sports federations, it was not clear whether the memberships related only to active individuals or also included administrative/volunteer members. Moreover, membership in a sport club is only a proxy for PA/sport practice. Indeed, the PA/sport level varies between members within a sport discipline. They can also be members in different sport clubs, and they can, obviously, practice PA on their own. In addition, the evaluated population varied considerably from one study to another. The cutoff age for the youth population differed between studies. Some studies defined a youth population as individuals aged under 18 or 19. Other studies included individuals aged over 16 in their samples of adults. Therefore, an age overlap may exist between youth and adult populations.

Most of the included studies had a poor study design quality. For example, articles rarely assessed changes in outcomes in the absence of elite sport events or successes (counterfactual analysis) and/or ignored key confounders affecting both outcomes and exposure (such as population and income). The empirical results are, therefore, often questionable.

Future studies should follow the same individuals before and after the intervention, measure the PA/sport practice more precisely (eg, using accelerometers), identify or create a control group that is not influenced by the intervention (eg, using a synthetic control method), and control the analysis for confounding variables.

## Limitations

This systematic review is not without limitations. The searches were conducted over a year ago, and additional research on the topic may have been published since. Some keywords (eg, mega-events, Commonwealth Games, FIFA World Cup) may have been missed in our Boolean equation. The methods we used to assess the quality of the extracted data, their analysis, and their interpretations were not optimal. Several tools are available to evaluate the quality of articles included in a systematic review. However, only few of them were suitable (at least partially) for the types of articles that were included in our systematic review. In our systematic review, the articles that presented high-quality evidence from large-scale cross-sectional studies/surveys within a wider narrative piece of work were rated with a low level of evidence and could have been rated with a low quality assessment (depending on how the data and the analysis were reported). For those articles, a low quality assessment may not change their results and their conclusions. For example, Bauman et al's<sup>48</sup> article, published in the *Lancet*, was rated as poor. This article synthesized data from other sources and did not replicate methodological data, which could have led to a

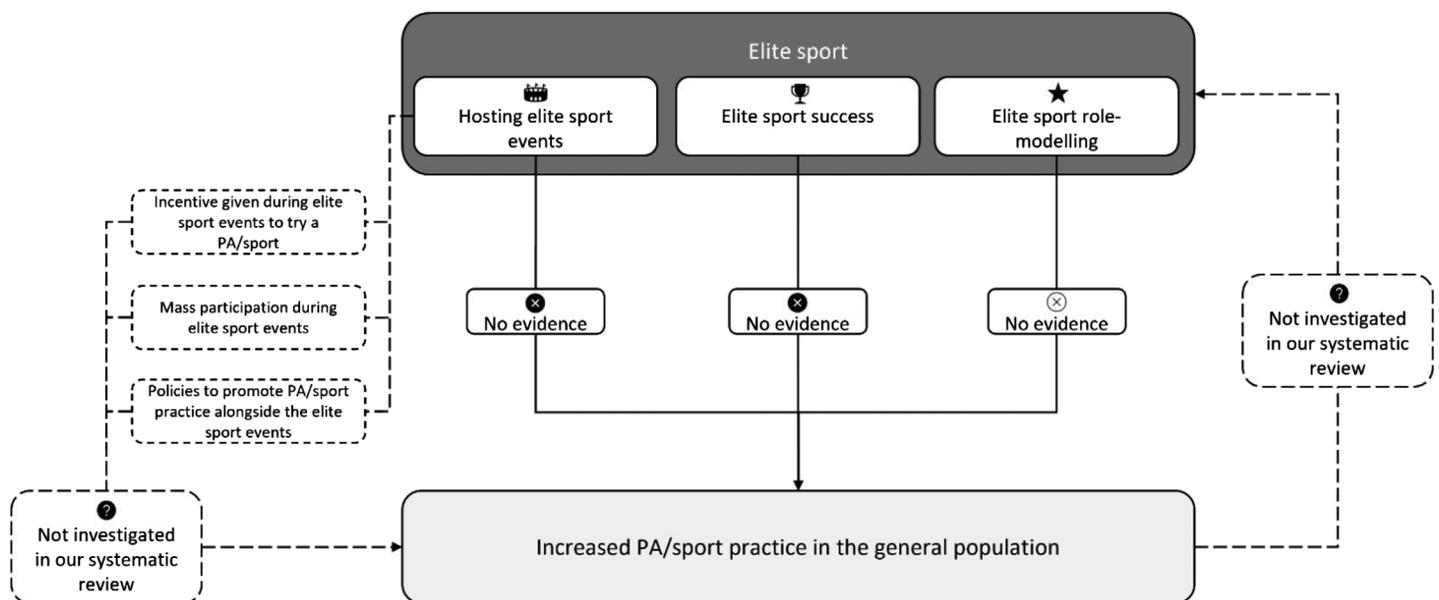
better quality scoring. Our method did not identify and assess the quality of original sources that were used by the included studies.

Several studies containing original data concerning the effect of elite sport on general PA/sport practice were not included in our systematic review because they were published in books or as working papers (ie, not peer reviewed).<sup>66,67</sup> We did not include studies that focused on the intention to engage in PA/sport. Attending or watching elite sport events may increase the intention to engage in PA/sport, especially because the spectators often are interested in PA/sport and are inclined to be active.<sup>17,68–70</sup> However, there is a huge gap between intention and engagement. We did not include studies evaluating the effect of elite sport events that mixed recreational and elite athletes (eg, city marathons). However, such events may have the potential to allow people to try PA/sport, usually in a spirit of social engagement with their friends. Such mass events may help to engage a part of the inactive population, but the motivation to be active may decrease over time.<sup>71</sup>

### Implications for the Decision Makers, Policymakers, and Other Stakeholders

Based on our results, we revised the assumed “virtuous cycle of sport” (also called “double pyramid theory of sport”),<sup>72</sup> which stipulated that elite sport would benefit from a large base of mass participants due to the talent pool it creates (Figure 2). Although there is no evidence indicating that a large pool of sport participants is either a necessary or a sufficient condition for sport success,<sup>73–75</sup> the “virtuous cycle of sport” is not likely to increase the pool of PA/sport participants in the general population, at least not through hosting elite sport events, elite sport success, or elite sport role modeling. However, decision makers and policymakers are still supporting elite sport with the aim of generating positive health

outcomes in the general population. For example, the World Health Organization (WHO) and the State of Qatar entered a 3-year collaboration project in 2021 “to make the 2022 FIFA World Cup, being held in Qatar, a beacon for physical and mental health promotion.”<sup>76</sup> Outstanding athletes are still invited in promoting PA/sport as well as healthy lifestyles. For example, in 2021, the football champion Didier Drogba was appointed WHO Ambassador for Sports and Health with the aim that “his support for WHO can help curb the growing burden of noncommunicable diseases through the promotion of healthy lifestyles, including the benefits of physical activity and sports for all people.”<sup>77</sup> In 2020, the WHO and the International Olympic Committee signed a new cooperation agreement “to promote healthy lifestyles, including physical activity, sport and active recreation, as a tool for health across the globe.”<sup>78</sup> To be efficient, such collaborations and governmental policies should not focus on elite sport alone to achieve health objectives. Indeed, we included 2 studies in our systematic review that presented interesting results that decision makers and policymakers could reflect on. In the first case, an increase in PA/sport participation in Spain was observed following the development of sport facilities across the country but not during the Spanish elite sport era.<sup>53</sup> In the second case, a significant increase in PA following elite sport events organized in Rotterdam (The Netherlands) was observed after 2010.<sup>44</sup> Since 2010, the city of Rotterdam has asked elite sport event organizers to provide a detailed plan explaining how PA/sport practice in the general population will be targeted and has required that a minimum of 10% of the total amount requested from the municipality will be used to support the organization of promotional side events. Researchers should increase knowledge on the effect of such interventions as well as the effect of elite sport success in different settings and the effect of elite sport role modeling on the PA/sport practice in the general



**Figure 2** — Revised version of the assumed “virtuous cycle of sport.” The “virtuous cycle of sport” stipulated that elite sport would benefit from a large base of mass participants due to the talent pool it creates. However, our systematic review showed no evidence (⊗) of effect on hosting elite sport events (🏟️) or effect of elite sport success (🏆) on PA/sport practice in the general population. We also showed no evidence (⊗) of elite sport role modeling (★), but the number of included studies was critical, which may lead to uncertainty. The dotted lines and dotted bubbles represent the facets of the “virtuous cycle of sport” that we did not investigate. The effect of incentive, policies, and mass participation within elite sport events to increase PA/sport in the general population and the need of a large pool of participants to elicit sport success remain to be investigated (🔍). PA indicates physical activity.

population. Elite sport events are missing the opportunity to leverage PA/sport participation not only in the general population but also in specific populations, such as persons with disabilities. For example, parasports events were integrated in the Glasgow 2014 Commonwealth Games. Although the event resulted in more accessible infrastructures and transport links for disabled people, it, however, missed the opportunity in planning for a legacy in programs at local and national levels to increase PA/sport participation in persons with disabilities.<sup>79</sup> Although at the strategic level, there is a wish for a legacy of elite sporting events to increase PA/sport participation, this is not supported by actions that could have demonstrated a significant effect beyond the normal temporality of the elite sporting events. The results of our systematic review may also find implications for the media, the elite sport event organizers, the sponsors, and the elite athletes themselves. As pointed out by Moscoso Sánchez et al,<sup>65</sup> “There is a need to convey a different view concerning sports, so that in the contest between humanistic values and materialistic values, those who contribute to the welfare of citizens and not to the growth of markets could achieve glory.”

Although the “virtuous circle of sport” is probably not likely to occur, elite sport may still have benefits for the entire population. Indeed, elite athletes contribute to improving the skills needed in different sports, which can subsequently be disseminated in the general population, increasing human skills (eg, the Fosbury flop technique in the high jump).<sup>80</sup> Elite sport contributes to the development of new technologies to increase performance (eg, running shoes), which can also be used by the general population.<sup>81</sup> Furthermore, research in elite sport has developed injury prevention strategies that are subsequently implemented in the general population, with benefits for their health.<sup>82</sup> There is evidence that elite athletes have a lower risk of death<sup>83</sup> and a higher quality of life.<sup>84</sup> Elite sport could, additionally, have other non-negligible effects on the economy and diplomacy.<sup>85,86</sup>

## Conclusion

Our systematic review showed no evidence to support an immediate or lagged effect of hosting elite sport events, elite sport success, or elite sport role modeling in increasing PA/sport participation in either young or adult populations. No effect was observed either locally or at a large-scale level. Although sport is still a pertinent vehicle to encourage populations to be active, the promotion of elite sport alone is not likely to increase the PA/sport practice at the population level. Decision makers and policymakers should, therefore, be aware of the limited effects of isolated elite sport promotion to improve active lifestyles in the general population and should adapt their actions accordingly to focus on and invest in more appropriate strategies, such as those recommended by the WHO.

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