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An evidence-based assessment of the impact of the Olympic Games on population levels of physical activity

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26 Summary

27
28 Pre-Olympic Games predictions commonly include an increase in population-based physical
29 activity in the host city, as often stated in the bid, but Post-Games effects on physical activity
30 have not been summarised. In this paper we: (a) examine mentions of a physical activity
31 legacy in pre-Olympic bid documentation; (b) analyse existing physical activity surveillance
32 data collected before, during and after the Games in hosting areas around the world; and (c)
33 evaluate *Google Trends* data surrounding the London 2012 Olympic Games as a case study
34 of community interest in the topic of “exercise” around the Games. Before 2007 limited
35 mention of physical activity was made in pre-Olympic documentation, but after that most
36 documents had targets for population physical activity or sport participation. The synthesis of
37 available surveillance data indicates no change in the prevalence of physical activity or sport
38 participation, except for Beijing and Nagano, although the increase in participation in Nagano
39 may not be attributable to the Games since there was no change in participation in winter
40 sports. The *Google Trends* data showed an acute spike in “Olympic” searches immediately
41 associated with the London Games period and sustained peri-Olympic increases in searches
42 for the topic “exercise”. The Olympic Games by themselves have not improved population-
43 wide physical activity but may be an important missed public health opportunity. Realising
44 such a legacy will require strategic planning and partnerships across the IOC, Olympic, sport
45 and public health agencies and a thorough evaluation framework implemented throughout the
46 pre- and post-Games period in the host country.

51 Introduction

52
53 Physical inactivity has been described as a global pandemic (1) that is responsible for a
54 substantial burden due to non-communicable diseases (NCDs), 5.3 million deaths and billions
55 of dollars every year (1,2). The World Health Organization Global Action Plan on Physical
56 Activity 2018 – 2030 suggests that best-practice communication strategies linked with
57 community-based programs and mass participation initiatives may be important contributors
58 to increasing population physical activity levels (3). The Olympic Games is the pinnacle of
59 human performance and an important global event to unite people from around the world
60 through a shared passion for sport. The Olympic spirit of *de Coubertin* was originally
61 described as the notion of “*taking part*” (rather than only focusing on elitism and obtaining
62 medals), and this provides a public health leverage point for fostering community
63 participation in sport and physical activity (4). The Olympic Games represents an important
64 opportunity to promote population-level physical activity and the purpose of this paper is to
65 provide an overview of the available evidence.

66
67 Planning for the Olympic Games includes consideration of legacies “bequeathed to the host
68 city (to) benefit its inhabitants for many years” (5). The term ‘legacy’ was first used in the
69 Melbourne bid for the 1956 Summer Games (6). Typically, Olympic Games legacies have
70 achieved health service improvements, communicable disease control, air quality and
71 environmental health benefits, urban health and regeneration, and sometimes improved
72 transportation systems (5,7).

73
74 There is untapped potential to use mass events to promote health behaviour changes that
75 reduce NCD risk, and the Olympics offers an opportunity for increasing physical activity

76 from a public health perspective (7). In the same way, aspirational public health goals for
77 previous Olympic Games have sought to promote health through non-smoking and healthy
78 food and beverage services (5,8,9). This promise of a 'physical activity / sport participation
79 legacy' is not well evidenced (10,11,12). Although the Olympic Games contribute to sports
80 facilities, sport education, and foster elite sports training programs (13), these effects only
81 reach high-level athletes, and are different to legacies promoting health-enhancing physical
82 activity and sport at the population level.

83
84 One mechanism through which Olympic elite sports are thought to increase population-level
85 physical activity and sport participation is through the alleged 'trickle down' effect whereby
86 elite sports participation is thought to lead to increased community interest and hence to more
87 people engaging in sport and physical activity. However, there is no evidence supporting this
88 'trickle-down' effect (14). The potential for the Olympic Games to promote population health
89 remains to be realised.

90
91 In this paper, we aim to provide a summary of the evidence of population physical activity
92 participation following the Olympic Games by: 1) reviewing pre-Olympic Bid documents
93 and identifying thematic mentions of physical activity and community sport participation; 2)
94 examining participation in physical activity and sport around the Olympic period in host
95 countries; and 3) exploring the temporal trends of population-level interest in 'exercise' using
96 London 2012 as a case study. The first step in this legacy enquiry involved an audit of
97 Olympic bid and policy documents regarding physical activity and community sport. For the
98 second question we extracted existing and publicly available physical activity or sport
99 participation population data from the host region or country to assess prevalence levels
100 before and after the Olympic Games. The third question examined community searching

101 behaviour on the Google platform before and after the London 2012 Olympic Games, with
102 time series modelling of the topic areas of “exercise” and “Olympics” to assess the temporal
103 relationships between community interest in these topics and the Olympic Games.

104 105 **Pre-Olympic bid documents**

106 We examined pre-Olympic Games bid documents, Olympic Games reports
107 (<https://library.olympic.org/Default/accueil.aspx>), International Olympic Committee (IOC)
108 reports, Government policy documents and other relevant grey literature for mention of
109 “legacy”, “legacy plan”, “physical activity”, “sport”, or “community participation” (Table 1).
110 We noted no mention of community sport or physical activity in bid documents or post-
111 Olympic Games reports until 2007/8 (15). The IOC had initiated an Olympic Games Global
112 Impact project in 2001, which suggested that Olympic cities collect indicator data before and
113 after the Games, that specifically included legacy information on grassroots sport
114 participation. The Beijing 2008 Summer and the Vancouver 2010 Winter Olympic Games
115 were the first to collect such information (16). The Beijing 2008, London 2012 and Tokyo
116 2020 bid information specifically mentioned community physical activity and sport
117 participation. Specifically, the Beijing Olympic Committee proposed to use the Olympic
118 Games as an inspiration to promote China’s nation-wide mass participation in sport and
119 fitness programs (“大众体育”, “全民健身”), together with educational campaigns fostering
120 the Olympic spirit. The London Olympics aspired to promote grassroots participation in
121 physical activity to “inspire a (younger) generation”. The Tokyo Olympics included specific
122 strategies (e.g., opening corporate sports facilities to the general public and hosting a “Sports
123 Day”) with specific and measurable targets (“the number of people who regularly do exercise
124 and sports”). Overall, increased mentions of community participation in physical activity and

125 sports reflect a positive change during the bidding process and planning for Summer Olympic
126 Games. No such change has been observed with the Winter Olympics.

127
128 **Population-level participation in physical activity and sports**

129 We searched for available or published data from regular population surveys in recent
130 Olympic host countries to examine temporal trends in physical activity and sport participation
131 (population physical activity or sport data sources and measures are shown in the
132 Supplementary Online file Appendix A). We selected population representative estimates that
133 used consistent physical activity or sport participation measures within-country spanning the
134 Olympic Game period in host cities, states or countries where data were available.

135
136 We present changes in participation rates for sport or physical activity, and the ratio of the
137 average pre-Olympic rates to the post-Olympic rates for both Summer and Winter Olympics
138 (Figure 1). Significance was not formally tested, but we report “non-substantial changes” in
139 situations where the prevalence rate 95% confidence intervals overlapped in the reported
140 estimates.

141
142 An earlier secondary report from the Barcelona 1992 Olympics provided information of a
143 municipality-wide survey that suggested increases in the proportion of the population who
144 did any physical or sporting activity at least weekly; but no reliable information regarding
145 this survey were available (17).

146
147 Population data from the state of Georgia (Atlanta) showed a slight but not substantial
148 increase in the years following the 1996 Olympics, as the 95% confidence limits for the post
149 Games estimates overlapped with those pre-Games (18). Japanese information before and

150 after the Nagano Winter Olympics showed a substantial increase in reported sport
151 participation, and an increase in mean step counts before the 1998 Games, but the mean step
152 count declined in subsequent years (19). Further, the increase in sport participation in Nagano
153 may not be attributable to the Games since there was no change in participation in winter
154 sports which are more relevant to the winter Games.

155
156 Sydney city data showed no change in sport participation (Figure 1), and a previous report
157 identified increases in community interest in exercise among Australian males following the
158 Sydney Olympics (20), but no change in population survey measures of physical activity
159 including sub-analyses confined to the state of New South Wales which includes Sydney
160 (20). Salt Lake City showed no increases in participation (18). No population physical
161 activity data were available for the Athens 2004 Olympics.

162
163 More recent data are shown in the middle and lower rows of Figure 1. Three large population
164 surveys from adults in China indicated steady improvement in leisure-time physical activity
165 with the percentage of participants meeting the recommendations for leisure-time physical
166 activity increasing from 17.2% in 2000 to 22.8% in 2014 (21), with similar increases reported
167 in all age groups under 55 years, and by gender and among urban/rural Chinese adults.

168
169 Increasing physical activity among children was a strong focus of the Vancouver 2010
170 Olympic Games, and especially surrounding the school setting (22). Data around the
171 Vancouver 2010 Winter Games indicated no change in objective Canplay population step-
172 count data among school-age children either nationally or in the province (British Columbia,
173 BC) in which Vancouver is situated (23). Further, the proportion of children reporting

174 organised sport participation did not change over this period and no evidence of the
175 anticipated 'trickle-down' effect was noted (23,24).

176
177 London reported data from serial Active People Surveys which showed an unchanged
178 prevalence of adults meeting the physical activity guidelines across the twelve years
179 measured. Data from the city of Rio de Janeiro suggest a small but non-substantial increase in
180 physical activity participation following the Olympic Games, although there was some
181 increase in Rio in the previous three years. Tokyo data are pre-Olympic Games, but do not
182 yet indicate any positive trends in mean step counts, exercise habit or sport participation up to
183 2017.

184
185 The left-hand section of Figure 1 summarises the average post/pre Olympics physical activity
186 prevalence ratio (with values larger than 1 indicating an increase from pre- to post-
187 Olympics). Data on one (sport participation) of the 4 measures following Nagano 1998
188 (winter), and leisure-time physical activity following Beijing 2008 (summer) showed greater
189 average prevalence rates following the Olympics, with no change in the other three measures
190 following Nagano, and no change in the other five Olympic Games.

191
192 Insert Panel 1 (text box and figure 2) about here

193
194 **Olympic Games and population participation in physical activity: what have we**
195 **learned?**

196 We found few examples of bid documents that included physical activity and sport
197 participation strategies into the pre-Olympic planning process. Although mass events and
198 mass campaigns to promote physical activity and sport are mentioned in the WHO Global

199 Action Plan on Physical Activity 2018 – 2030 (3), the global public health potential for
200 raising community awareness about physical activity through the Olympics remains to be
201 realised. Links to the concept of “Sport for All” and the promotion of community sporting
202 programs for the general population are not evident.

203
204 National policy statements often allude to physical activity and sport such as the extensive
205 policy framework preceding the London 2012 Olympics (Table 1). There was some evidence
206 of increased and sustained interest in exercise, demonstrated through the search-term
207 increases using Google Trends around the London Olympics, but the prevalence of meeting
208 physical activity guidelines among adults in England remained unchanged before, during and
209 after the London Games. This suggests that London’s attempt to increase grassroots
210 participation in physical activity and sport may have led to an overall improvement in public
211 awareness and policy interest in physical activity, however, this did not translate in the
212 medium-term into increased levels of participation. Other recent host cities also failed to
213 demonstrate post-Olympics increases in participation, including self-report measures of sport
214 participation (Vancouver) and physical activity (Sydney, Rio) and objective step-counts
215 (Vancouver). Of note, there was an increase in population levels of “intention to be more
216 active” seen immediately following the Sydney Olympics, suggesting increased community
217 interest in being active, but this was not associated with any change in physical activity
218 behaviour (20).

219
220 The Beijing 2008 Olympic Games appeared to use the Olympic opportunity to develop
221 national policies that invested in physical activity participation. Between 2001, when Beijing
222 won the bid, and 2008 when the event took place, comprehensive policies and guidelines on
223 mass participation in physical activity and “Sports for All” were implemented at the national

224 and city level. This comprised community sporting infrastructure construction, educational
225 campaigns and community sporting events, providing a “systems-level” integrated response
226 that may have contributed to the observed increase in population participation in leisure-time
227 physical activity, and to sustained sport policy development (25).

228

229 **Physical Activity Legacy: Recommendations for future Olympic Games and Mass**

230 **Sporting Events**

231 The Olympic Games Global Impact report provided a framework for including sport
232 participation and physical activity as a long-term legacy of the Olympic Games, but limited
233 evidence is available to show that this vision has been implemented, or that such strategies
234 have been effective. In order to achieve this vision, a comprehensive national physical
235 activity and sport plan is needed, which starts well before the Olympic Games, and is
236 continued beyond the end of the Games. To capitalise on a successful Olympics bid,
237 countries should create strong inter-agency *partnerships* at multiple levels. This should
238 include partnerships between the IOC, local Olympic committees and multiple sectors across
239 the host national Government, and also between community organisations that deliver local
240 opportunities for physical activity. These partnerships would deliver a comprehensive set of
241 community programs leading up to the Olympic Games to strengthen the sport sector and to
242 increase population physical activity levels. To date, Olympic planners seldom work in
243 partnership with Public Health agencies and community sports groups throughout the peri-
244 Games periods to produce real public health effects (26); rather there has been an expectation
245 that the ‘trickle-down effect’ will inspire the community (10,27,28).

246

247 The Olympic Games could be a catalyst for action to promote physical activity at scale (29).

248 One advantage of the Olympics is the huge investment over multiple years, which may allow

249 public health planning to be developed in tandem. This may be possible with other global
250 sporting events, but is less likely with local sporting contests or single day physical activity
251 events. In any case, concurrent mass communications are needed to promote the public health
252 idea about physical activity. Messages should not only focus on the heroics of elite sports
253 professionals but use the opportunity of the Olympics to raise awareness about everyday
254 'movement for all', at every level in a society, and to link community activity to the spirit of
255 the Olympics. Mass reach messages need to carefully promote the 'moderate physical
256 activity' message (3), otherwise low active people may be discouraged from starting to move
257 more (30).

258
259 As noted in the Google Analytics modelling, the increased interest in sport and exercise
260 around the Olympics may provide an opportunity for physical activity promotion. This
261 hypothetical increase in community interest needs to be supported by peri-Olympics related
262 changes to urban infrastructure, park and sports facility development, and public transport
263 systems that will support incidental physical activity and community sport. This process was
264 best realised around the Beijing Olympics in 2008, where Government commitment to
265 facilities and community education continued throughout the peri-Olympic period. Non-
266 Olympic nations should use the quadrennial opportunity of the Games to promote sport and
267 activity in their countries. Similarly, community-wide social marketing should accompany
268 other global mega-sporting events to create more active communities through role modelling.

269
270 This paper has focused on the Olympic Games, and a similar dearth of evidence exists for the
271 effects of other 'mega-events', such as World Cup Football, and possibly Grand Slam tennis
272 events on physical activity at the population level (31). A related area is mass community
273 walking, cycling, running or other participation events, including those carried out by non-

274 Government Organisations or charities. These are usually ‘one off’ annual events and
275 encourage social connection, charitable sponsorship and community spirit. Although they
276 have large participant numbers, they often attract people who are already active (32-34), or
277 attract highly selected participants (35). However, some mass events do attract large numbers
278 of walkers or low active people, such as an annual mass event of 50,000 participants in
279 Ireland (36). However, participation in activity may be maximal around the event, and relapse
280 to low levels of activity is seen (33). It is possible that widescale adoption of regular weekly
281 local events, such as *parkrun* (37) may better maintain participation within communities.
282 Although few have been evaluated, these mass events have the potential for being natural
283 experiments, to assess different reinforcement and support strategies at both the municipal
284 and community-wide levels. This further evidence is necessary to determine whether inactive
285 people develop sustained physically active lifestyles following community events.

286 Independent monitoring and evaluation frameworks are essential to assess the long-term
287 evidence for integrated approaches around the hosting of the Olympic Games on population
288 physical activity (29,38). If we assume that the Olympic Games has the potential to be ‘a
289 physical activity intervention at scale’, then it should be comprised of organizational, policy
290 and communitywide changes. Figure 3 shows our chronological ‘systems based’ logic model
291 that describes the planning and evaluation actions required (3). A comprehensive process
292 evaluation framework is needed to monitor policy implementation, the engagement of
293 stakeholders and partnerships, and assess capacity-building for physical activity and
294 community sport. Stable planning policy frameworks, rather than ‘shifting goalposts’ are
295 required to maintain cross-sectoral and sustainable progress in community programs and
296 infrastructure (26). Existing population surveillance systems could be adapted to better
297 monitor physical activity and sport participation among adults and children.

299 Attribution of physical activity behaviour change to the Olympics remains a methodological
300 challenge. Observed increases in physical activity around the Olympics may be due to other
301 policy or programmatic initiatives. In Rio de Janeiro, several factors changed around 2010
302 including economic and social prosperity, leading to more private physical activity facilities
303 and the scaled-up implementation of national and state physical activity programs (26,27),
304 which may have influenced increases in pre-Games physical activity. These data demonstrate
305 temporal correlation (i.e., occurrence) rather than causation and it is not possible to attribute
306 changes directly to the Olympics as a “natural experiment”; however, the paucity of
307 substantial increases in the years following the Olympics do suggest no direct Olympic
308 Games effects to date.

309

310 Some of the allure of the Olympic Games relates to showcasing and profiling the host city
311 and nation, while promising benefits to the populace. Politicians develop a “monument
312 complex” (39) with the belief that the health and wellbeing of host cities will be substantively
313 improved through hosting the Olympics. The Games may engender community enthusiasm, a
314 ‘festival’ spirit and a transient sense of wellbeing in the host city (40). Achieving physical
315 activity and sport participation improvements and realising the social and economic benefits
316 that would result from reducing the ‘physical inactivity pandemic’ (1,41), require more
317 focused and integrated efforts implemented over many years.

318

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Table 1. Pre-Olympic policy statements about physical activity (PA), sport and related legacies

Olympic Host City	Title of Olympic policy / planning document(s)	Physical activity/ sport policy statements / promise	Other legacies mentioned in pre- and post-Olympic documents relevant to sport or PA
Barcelona 1992 (Summer Games)	Official Report of the Games of the XXV Olympiad Barcelona 1992; Bid document 1986 (Candidature file)	No mention of physical activity or community participation; develop “amateur sport” (Bid p4).	Official post Games report only mentions “legacy” of sport infrastructure
Lillehammer 1994 (Winter Games)	Bid documentation (Candidature file) 1987	“legacy” term not used; no mention of physical activity or community sport participation	Not known
Atlanta 1996 (Summer Games)	https://www.georgiaencyclopedia.org/articles/sports-outdoor-recreation/olympic-games-1996 and Olympic Bid (Candidature file) 1990	No mention of physical activity or community sport participation.	Atlanta sporting facilities, pedestrianisation, housing and building projects; legacy of community sport events
Nagano 1998 (Winter Games)	Nagano Winter Olympics Bidding Committee. (1991) "1998 NAGANO JAPAN" (Official bid file); Nagano City. (1990) “1998 Olympic Winter Games Plan” Nagano City, Nagano. [In Japanese]	No mention of PA legacy; mention of sports facilities	“The athletic facilities will continue to be enjoyed by athletes and sports enthusiasts” (p.10, Bid file)
Sydney 2000 (Summer Games)	IOC Summer OG bid, 1993. IOC library (Bid : Candidature file)	No mention of PA or community sport participation	Mention of community sports facilities; mention of sporting facility and parklands legacy [Bid file vol 2:12.24:5] Legacy of transport [2:5,20,76]
Salt Lake City 2002 (Winter Games)	Olympic bid document 1990	No mention of physical activity or sport participation	Community program, “A Healthier You 2002.”
Athens 2004 (Summer Games)	Official report of the Summer Olympic Games Athens 2004. ISBN 9608810175 (volume 1); 9608810183	No mention of PA or sport legacy	Public transportation legacy

	(volume 2)		
Turin 2006 (Winter Games)	https://www.olympic.org/news/how-turin-was-transformed-by-hosting-an-olympic-winter-games. ; Torino 2006 Olympic Bid Volumes1-3 in Watts compilation (2014)	No mention of physical activity or community sport in bid documents	Twenty-five “Olympic ring education initiatives” engaged over 600,000 schoolchildren
Beijing 2008 (Summer Games)	Bid document. Official report of the Beijing 2008 Olympic Games Vol 1; Dapeng et al 2010 ; Watts compilation: Beijing Bid 17:1	inspired China’s nation-wide fitness program”.... “... young people can benefit from the Olympic experience and become promoters of the Olympic spirit.”	Eco-friendly and energy saving; “athletes-centered” perspective in planning venues and facilities;
Vancouver 2010 (Winter Games)	Canadian Sport policy Federal/Provincial/Territory priorities for collaborative action 2007-2012 Vancouver 2010 Bid report , 2009	No mention of PA or community sport participation;	Create "sustainable legacies for athletes / sport development " ; (environmentally friendly) transport systems; Aboriginal and Youth sport legacy; Action Schools BC (a dissemination project for activity in schools).
London 2012 (Summer Games)	Series of Government Department policy documents <u>2007-2012 **</u>	increase grass roots participation, particularly by young people ; to encourage the whole population to be more physically active [c,d]; ...exploits of our elite athletes will inspire young people.. ...to get into sport... long-term step change in the number of people who play sport, is to create a sporting habit amongst young people [e]	Urban transformation; Olympic Park a blueprint for sustainable living [a,b,d]; economic and community engagement [c,d]

Sochi 2014 (Winter Games)	IOC 2014 Evaluation Commission Report, XXII Olympic Winter Games 2014	No mention of physical activity or community sport participation	New infrastructure and transport; legal for sports 454 455
Rio de Janeiro 2016 (Summer Games)	Caderno Legado Social (Social Legacy Report of the Rio 2016 Games) http://www.cesmac.edu.br/admin/wp-content/uploads/2014/11/cadernoLegadosSocial-1.pdf ; Live your passion; Rio 2016 candidate city	expand the reach of sports and physical activity programs to citizens. No mention of physical activity or sport participation in “Live your passion” document	Municipalities and community-based organizations. Infrastructure and transport development; young athlete scholarships, training facilities; sport infrastructure 456 457 458 459
Pyeong-chang 2018 (Winter Games)	IOC PyeongChang report, Vol 1 (in Watts compilation)	No mention of physical activity or community sport	hub of winter sports in Asia, Olympic Legacy Development Fund (p25) 460
Tokyo 2020 (Summer Games)	The Tokyo Organising Committee of the Olympic and Paralympic Games. (2016) Tokyo 2020 Action and Legacy plan 2016	..increase in number of people who regularly do exercises and sports ... (increase in sport participation), promotion of sports among employees and residents	Designated ‘Sports Day’; opening corporate sports facilities to the general public; pillar of sport and health 461 462 463

464 Legend:

465 ** 2007 Dept Culture, Media and Sport (DCMS) Winning: Tourism Strategy for 2012 and Beyond [a] 2007 DCMS: Our Promise 2012 [b]
466 2008 DCMS: Before, During and After –making the most of London Games [c] , 2010 DCMS: Plans for OG legacy [d] , 2012 DCMS:
467 Creating a sporting habit for life –new youth sport strategy [e], 2012 DCMS: Beyond 2012 –the London 2012 legacy story [f]

468 Notes: Olympic bid data from IOC library, Lausanne <https://library.olympic.org/> or from a private curated compilation (accessed August 2020)
469 Watts T: <https://issuu.com/thatsnotmypuppy>

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Figure 1. Trends in population sport or physical activity participation for host Olympic cities or nations

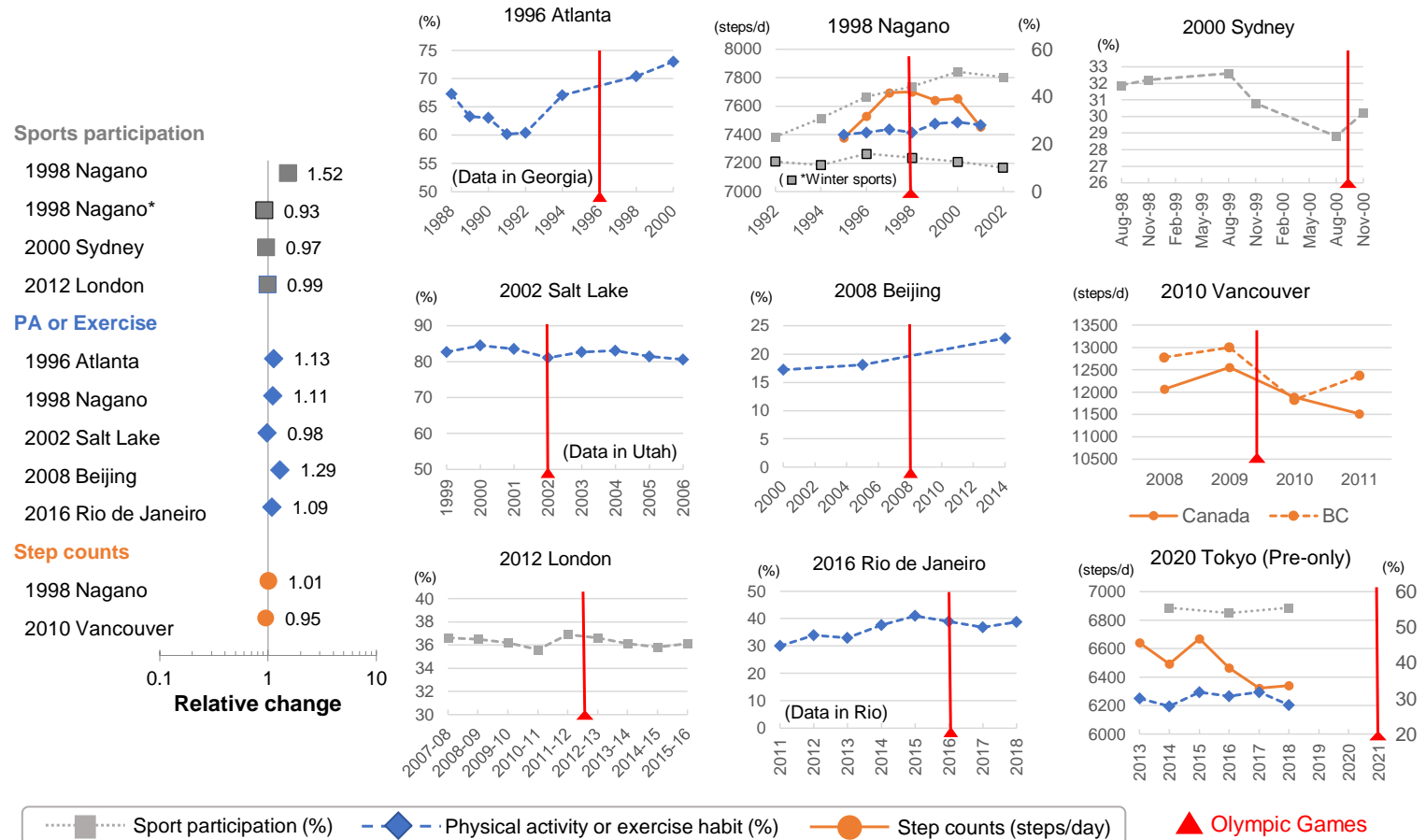


Figure: Population-level physical activity before and after the Olympic Games in the hosting countries.

PA: physical activity, BC: British Columbia. Physical activity data are from nationally representative samples unless otherwise stated. Relative change was obtained by dividing the post average by the pre average. Relative change greater than 1.0 indicates that population-level physical activity increased after the Olympic Games. *Winter sports participation. Detailed information about the measures for each country can be found in Supplementary Online file, Appendix B.

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Panel 1. Population-level interest in physical activity during the 2012 London Olympic Games

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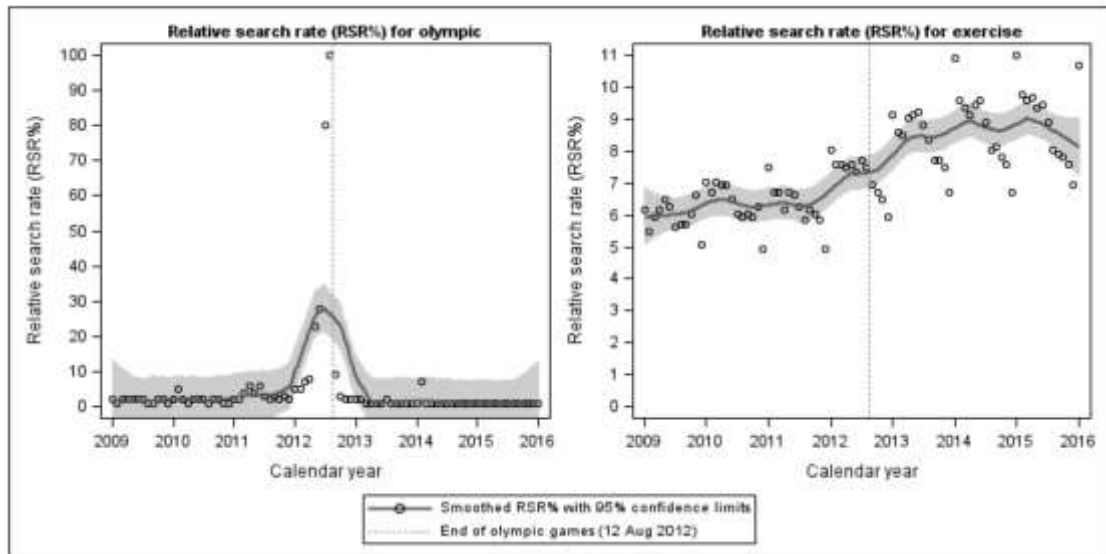
In recent years, Google Trends has been recognised as an innovative and valuable tool for “infoepidemiology” and “infoveillance”¹, which has been successfully used to predict infectious disease outbreaks, evaluate tobacco control policies^{2,3} and track community interest in physical activity and exercise during the pandemic of COVID-19⁴. Not all Google trends data are accurate, and may overestimate influenza outbreaks. We used Google data in a different way, to assess subjective community interest in participating in exercise and physical activity during the Olympic Games period. We used this as a hypothesis generating analysis, to provide supplementary evidence to the prevalence data included in Figure 1, based on the assumption that changes in community interest, intention and information-seeking precede changes in behaviours. Previous population survey data in evaluating the Sydney Olympics showed an increase in community interest regarding exercise, but no change in physical activity prevalence. No such data were available for other Olympic Games, so we present this method as a tentative, but innovative approach to assessing changes in community interest.

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We selected the 2012 Summer Olympic Games as a case study and modelled the population-level interest in “Olympic Games” in contrast to the topic of “exercise” between 2009 and 2016, before and after the London Olympics (see Supplementary Online Appendix B for methodology). Using Interrupted time series analysis, results show an acute surge in “Olympic” searches immediately associated with the Olympic Games period. The right hand panel shows a clear increase in search queries related to “exercise” immediately leading up to the London Olympics, and a continued (but not significantly different) post-Olympics increase in “exercise” until June 2013 [See Online Appendix B]. In conclusion, the UK population may have become more interested in exercise during the time of the 2012 London Olympic Games. While the skyrocketing interest in this mass sporting event was fleeting, the interest in physical activity-related behavioural change may have been more sustained. The purpose of this analysis is illustrative, to show how ‘big data’ can be used for real-time assessment of community interest around the Olympic Games. Data of the public’s online searching behaviour may reflect community interest and does not translate to population-level increase in physical activity engagement and should always be triangulated against other information, such as that from long-term surveillance systems.

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Figure 2. Trends in Google searches for the topics “Olympic” and “Exercise” around the London 2012 Olympic Games



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507 References for (Text Box) Panel 1:

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1 Mavragani A, Ochoa G. Google Trends in infodemiology and infoveillance: Methodology framework. *JMIR Public Health Surveill* 2019;5(2):e13439; [2] Troelstra SA et al Effect of tobacco control policies on information seeking for smoking cessation in the Netherlands: A Google Trends study. *PLoS ONE* 2016;11(2): e0148489; [3] ³ Pelat C, Turbelin C, Bar-Hen A, Flahault A, Valleron AJ. More diseases tracked by using Google Trends. *Emerging infectious diseases*. 2009 Aug;15(8):1327; and Hay SI, George DB, Moyes CL, Brownstein JS. Big data opportunities for global infectious disease surveillance. *PLoS med*. 2013 Apr 2;10(4):e1001413; [4] Ding D, del Pozo Cruz B, Green MA, Bauman AE. Is the COVID-19 lockdown nudging people to be more active: a big data analysis. *Brit J Sports Med* , March 2020. {5} Lazer, D, et al (2014). The Parable of Google Flu: Traps in Big Data Analysis. *Science* 343(6176): 1203., also Lazar D. (2015) *WIRED*. <https://www.wired.com/2015/10/can-learn-epic-failure-google-flu-trends/>

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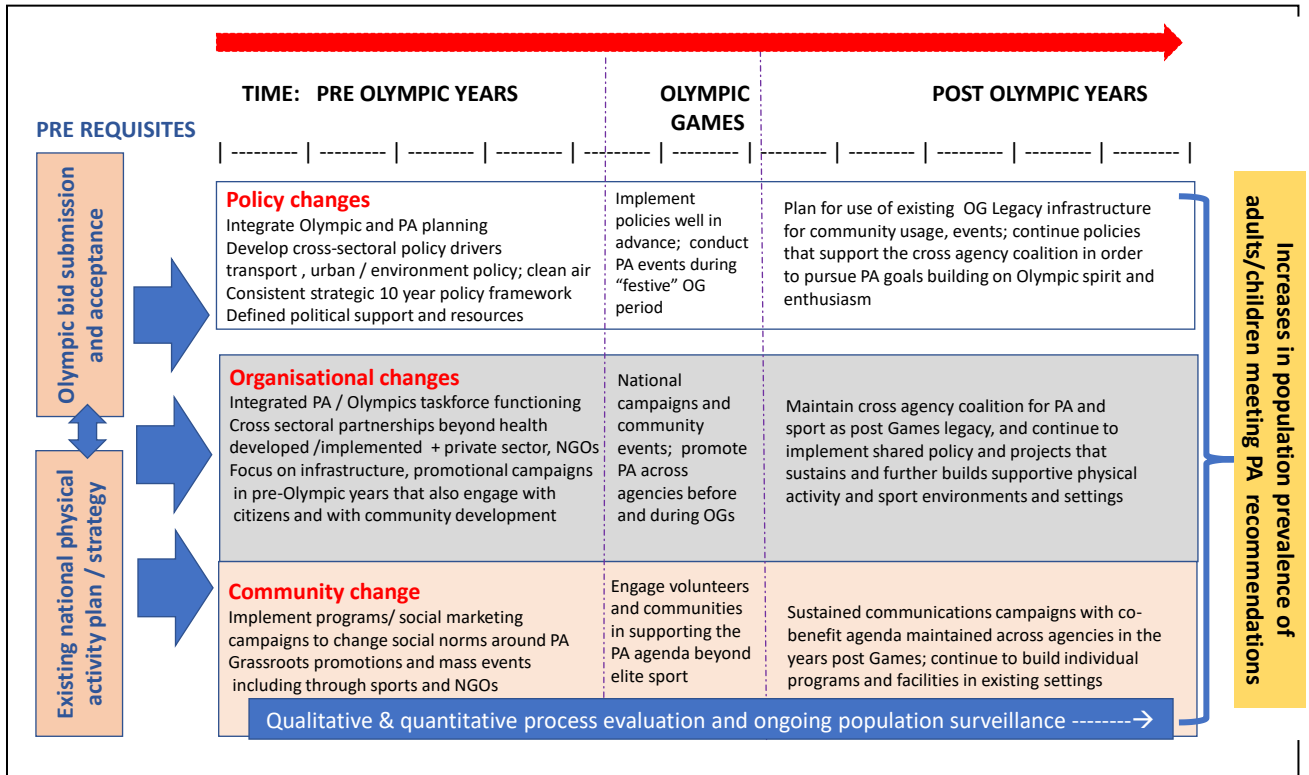


Figure 3. Multi-year conceptual framework (logic model) for assessing whether the Olympic Games influences population physical activity or sport participation