

# Planetary Health and the Olympic Games

## Planetare Gesundheit und die Olympischen Spiele

**The Olympic Games are the largest global multi-sport event, bringing together the world's best athletes every four years. For the Games in Paris 2024, more than 200,000 people will be accredited for the event, including security and service personnel, 10,500 athletes, their entourages, organisers, volunteers and more than 20,000 media representatives (4). The Paris 2024 Olympic Games will sell up to 8 million tickets for 329 medal events in 32 sports to which 204 National Olympic Committees have been invited.**

The International Olympic Committee (IOC), which owns the Games, is an international NGO with a strong pro-social mission to promote education and peace (3). This is the basis of its moral legitimacy. The IOC uses commercialisation to promote Olympism, which is encapsulated in seven principles in the Olympic Charter. This charter describes the concept, ownership and cognitive legitimacy of the Olympic Movement and the Olympic Games (27).

“The Olympic Movement is the concerted, organised, universal and permanent action, carried out under the supreme authority of the IOC, of all individuals and entities who are inspired by the values of Olympism “. (IOC charter, (3)) “The IOC is the owner of all rights in and to the OG and Olympic properties”. (IOC charter §7.1, (3))

On this basis, the IOC is practically forced to look after the health of those involved in the Olympic Games, particularly the athletes. This is also stated in the duties of the IOC:

“to encourage and support measures relating to the medical care and health of athletes” (IOC charter, §2.10, (3)).

By being bound to the Olympic Charter, the International Federations (IOC charter, §26.1.1.8, (3)) and National Olympic Committees (IOC charter, §27.2.2.8, (3)) are also bound to take care of the athletes' health.

But it is not just the local population and the Olympic athletes that are the focus. As the world's largest multi-sport event, the Olympic Games bring together people from all corners of the globe, posing significant organisational challenges and requiring rigorous safety and public health measures in the host cities. Held in different cities and climates, the Games expose participants and spectators to various health risks. Participants may carry pathogens from their home regions and lack immunity to local diseases, reflecting the broader health challenges of globalisation.

The Olympic Games have the potential of making a positive impact on planetary health. They can be a catalyst for sustainable development by highlighting global health issues and promoting green practices, demonstrating how international events can contribute to a healthier planet.

### Olympic Movement, Physical Activity and Impact on Non-Communicable Diseases

The Olympic movement has also a role because worldwide the levels of physical activity are insufficient and the global age-standardized prevalence of insufficient physical activity has increased from 26.4% in 2010 to 31.3% in 2022 (37). Non-communicable diseases (NCDs), including coronary heart disease, stroke, hypertension, type 2 diabetes, dementia, depression and cancers, rise simultaneously, are associated with a lack of physical activity and can be prevented and treated with prescription of exercise and physical activity (24). In consequence, the United Nations, IOC, WHO, governments and many international societies will cooperate in globally promoting physical activity (1, 23, 36).

A combination of evidence-based policy actions is needed to create active societies, environments, and people integrated in comprehensive a whole-system approach (36). Ecological and multilevel actions that consider personal, environmental and political factors should address physical inactivity. This means that the development of policies at all levels – cities, regions, states and countries – is important (18, 20). The solicitation of knowledge, experience, judgement and values from all stakeholders involved including the target population is important (12, 18). Stakeholder involvement also serves to create a shared understanding and transparent decisions (8, 12).

Olympic cities can serve as catalysts to improve the health of their populations (36). France Stratégie estimates the social cost of physical inactivity in France at around €140 billion per year (14), so it is worth taking advantage of events to reduce these costs. Therefore, Paris 2024 has focused on sedentary lifestyles and lack of physical activity among children, adult and working populations and launched 19 health-related projects (4).

### Public Transport and Active Transportation

The increase in greenhouse gas emissions caused by human activities (infrastructure, intensive agriculture, the textile industry, etc.) is wreaking

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havoc on the climate system and could make sport unviable, thus working against a healthier planet (13, 34). The Paris 2024 ecosystem, the sports movement and individuals are using sport as a powerful engine for progress in the environmental transition (2, 4).

The Olympic Games tend to stimulate new and expanded sustainable, resource-efficient development. Since at least the 1960s, the Olympic Games have been used as a catalyst for urban development (10), with the 1972 Olympic Games in Munich as the first outstanding example. In the bidding process, Munich presented a novel concept of a cosmopolitan, less pompous event, which proved highly persuasive to most IOC members, who ultimately chose Munich over Montreal, Madrid and Detroit. The slogan „Olympic Games of short distances“ was also chosen by the IOC as a convincing argument for the location of the event (6). This concept has only been revised today, fifty years later, by „The New Norm“, which allows the inclusion of venues in other regions. In this way, Munich influenced the design of Olympic cities for almost half a century. The „short distances“ were of great value in terms of post-use considerations, as they facilitated a geographical proximity between housing (Olympic and Media Village) and sports venues.

Other cities followed with significant acceleration efforts in their public transport systems. The investments in metro systems in Barcelona 1992, Atlanta 1996 (17), Athens 2004 and Rio 2016, have impacted on active transport and physical activity (43).

The efforts of the Paris vision to encourage its citizens to move more and to create an active society have become a reality (2, 4). The many projects initiated by a government „endowment fund“ have provided many possibilities to participate in physical activity. For example, Paris is planning compact Games, with around 80% of the venues in and around Paris within a 10 km radius of the Athletes' Village, and 85% of the athletes will live less than 30 minutes from their competition venue (2, 14). These short distances reduce the CO<sub>2</sub> emissions associated with athlete travel.

Spectators will have to use public transport to reach the venues and active mobility will be encouraged. The use of bicycles will be promoted in the Île-de-France region and temporary bicycle parking facilities will be provided near the venues, 415 km of cycle paths have been developed (4).

However, the biggest carbon footprint of such a mega-event remains the transportation of all the people attending and participating in the events. According to the sustainability report, this accounts for around 30% of the total footprint (4).

### Air Quality and Fine Dust

It is not just the CO<sub>2</sub> from construction and transport that is a health problem, but also the particulate matter that the Olympic Games produce. This is a serious problem for high-performance sports. The deterioration of air quality in many megacities since the second half of the 20th century has become a constant concern (34, 41). The subjective perception has been more disturbed than the awareness of the health effects. When Beijing was awarded the 2008 Olympic Games, we were confronted for the first time with severe heat and immense particulate pollution (19). „The sun is shining, but you don't know where“ was an apt description of the weather in China's major cities.

In the same decade, research was published showing that particulate matter was the cause of cardiovascular and pul-

monary disease (7, 9, 22, 34), and the cause of systemic inflammation and oxidative stress (7). Increasing evidence showed that high fine particulate matter in the air correlates not only with airway symptoms, asthma and COPD (Chronic Obstructive Pulmonary Disease) but also with cardiovascular events and mortality (34). Studies showed that the incidence of disease along major traffic routes (21) and areas of low socioeconomic status SES (16) was significantly higher than in areas with greenery and traffic calming.

Olympic Games are a kind of „natural experiment“ on air pollution levels due to Olympic-related environmental regulations (30), e.g. in Atlanta 1996 (17) and Beijing 2008 (19).

Once the public health problem in Beijing was identified and defined, significant efforts were made in the years leading up to the Beijing 2008 Games and beyond as a legacy of the Games. Over the past 15 years, Beijing has steadily improved its air quality. It reduced particulate fine matter 2.5 µm (PM 2.5) levels by 47% between 2005 and 2015 as an initiative of the Games, and further efforts were made in the run-up to the Beijing 2022 Olympic Winter Games. In August 2019, Beijing recorded its lowest ever monthly air pollution level, with a low of 23 µg/m<sup>3</sup>. The main reasons for the reduction in Beijing's air pollution are based on urban renewal, such as the switch from coal to natural gas in power plants, the large number of electric vehicles used by the population, and the Chinese government's efforts to stop deforestation in the wider area (41). The local authorities in Beijing realized how successful their traffic reduction policy had been for the 2008 Olympics. The most common way to reduce traffic is to ban certain vehicles from certain areas on certain days of the week (19, 41, 43).

Overall, the Olympic Games now contribute to a significant improvement in air quality in the long term (not only during the Games themselves) by replacing part of the bus fleet and cabs, fitting vehicles with catalytic converters and filters, investing in filtration systems for power stations and industrial plants, covering construction site embankments to stop the wind blowing away dust, more efficient civil heating systems and more road traffic restrictions.

Senese et al. conclude that the infrastructure works for the Olympic Games affected the air quality in terms of NO<sub>2</sub> and PM 10 µm concentrations in the Turin 2006 Games (32).

During the London 2012 Olympic Games, the issue of particulate matter was much debated because of high levels of particulate matter in underground stations and on the trains themselves caused by brake wear (31). A practical solution is to better ventilate polluted areas and filter the air (34). In the future, particulate filters and regular street cleaning will be a solution to reduce particulate matter on polluted streets and intersections.

### Heat and Climate Change

Extreme heat can cause a decline in the performance and health of athletes, potentially forcing the postponement of events, the abandonment of races and/or leading to serious heat-related illnesses (13).

The Olympic Games and other major sporting events face many challenges in providing optimal health care for athletes, spectators and organisers. The Summer Olympic Games and most international summer sports events are often held during the hottest months of the year. A major challenge for athlete (and spectators' and officials') health is the prevention and treatment of heat-related illness (33, 40).

At the 2004 Athens Olympics, awareness of heat related illnesses was low, even though the role model for the Olym- ➤

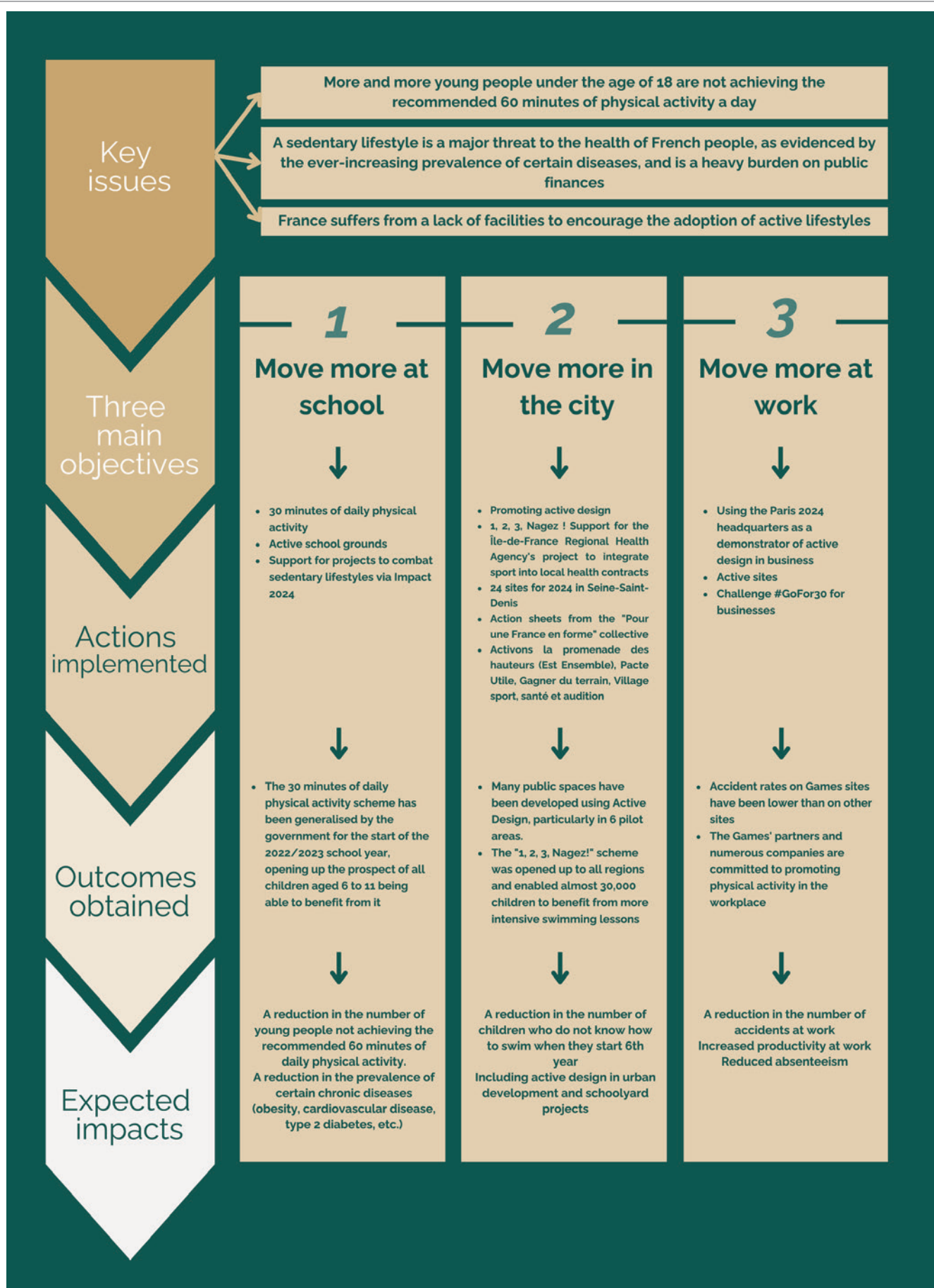


Figure 1

Health challenges from the Paris 2024 Sustainability & Legacy Pre-Games report summary (4).



Amount in euros	<b>€11,763,903</b> including €2,000,000 for the 1, 2, 3, Swim! programme.
Number of projects	<b>322</b> including 53 under the 1, 2, 3, Swim! programme
Estimated number of direct beneficiaries	<b>961,801 direct beneficiaries</b> Including 6,200 under the 1, 2, 3, Swim! programme.
Estimated number of direct beneficiaries based on Impact 2024 project reports	<b>568,463</b>
Number of people with disabilities as beneficiaries (forecast based on interim reports provided by project sponsors)	<b>67,941</b>

**Figure 2**  
Investments in „health“ actions for the Paris 2024 Sustainability & Legacy program (4).

pic marathon was the messenger Pheidippides, who probably died of heat exhaustion. We have been building climate models and taking measurements for the Beijing Olympics since 2007. Temperatures in the Olympic stadium could easily exceed 70 degrees on sunny days, tents or black asphalt surfaces are risk zones (33, 40). Finally, in the run-up to the Tokyo 2020 Olympic Games, temperature issues were the subject of intense debate (40). Clinical publications dealt with specific heat-related health risks for athletes, such as Hypovolaemia and the potential impact of pre-cooling on performance, as well as guidance on acclimatization for safety and reduced fatigue. Integrated heat management to prepare for heat-related health risks requires adaptive approaches on different temporal and spatial scales (28). For example, advanced forecasting of planetary and local weather patterns for heat exposure in Tokyo provides advanced and actionable weather information for preparedness (40). An international IOC working group addressed prevention and management of heat-related illnesses, and medical teams were trained and educated. Thus, the postponement of Tokyo 2020 (28) provided an unexpected opportunity for a coalition of researchers, practitioners and organizers to further optimize strategies to mitigate the risk of extreme heat, but now with additional considerations to address potential COVID-related issues (33). Such precautions could further increase heat vulnerability. Through coordinated efforts, Tokyo 2020 leaves a legacy for future mass participation events that may face the multifaceted challenges of extreme heat (28, 40).

But heat does not just affect athletes. Studies of heat waves in southern France, for example, have shown significant excess mortality among the elderly and those with health problems (13). Sport is also affected by high ambient temperatures, for example when events are awarded to the Gulf States (Qatar, Saudi Arabia or the United Arab Emirates). Structural measures (e.g. shading or air conditioning in medical areas) and personal measures for athletes and spectators have been put in place for all the Games, not just there. At the opening ceremony of the Beijing Olympics, each spectator was given a bottle of water on the field and a baseball cap to protect them from the sun. The provision of free water to athletes at international competitions was not a matter of course in the past and was enforced by international sports federations with the support of the IOC.

But structural measures have also been taken, including natural shading through the creation of green spaces, trees

and parks. For Paris 2024, the only newly built facility, the Saint-Denis Olympic Aquatic Centre, has a wooden frame, a real innovation, with a span of 90 metres and a concave shape to reduce the heated and ventilated internal volume by 30% compared to a flat roof (2, 4).

Climate change and global warming are major challenges for sport. There are already areas of the world where no sport or physical activity is possible during the day. In these areas, physical work is also the main risk factor for heat-related illness and premature death. It is important that sport contributes to improving livelihoods in all regions of the world, including

improving the natural environment for sport and physical activity. In this respect, Olympic sport is a partner in global climate efforts.

### Hygiene of Public Waters, Groundwater and Sports Facilities

For many decades, wastewater treatment in many cities focused on getting wastewater out of the city as quickly as possible, using rivers and waterways as cesspools and accepting the resulting deterioration in water quality. As a result, the flora and fauna of the waterways were severely disturbed, making the waterways unsuitable for recreation.

At the Sydney Olympics 2000, canoe slalom events were held in water contaminated with faecal bacteria. Homebush Bay was highly contaminated, and the groundwater was severely affected. Strategies to remediate the Homebush Bay site included capping, excavation and mounding, building a waste treatment plant (38). The “sea water forest” in Tokyo was a similar site but effectively managed.

In preparation for the Rio 2016 Olympic Games, Brazilian medical associations highlighted the lack of wastewater treatment plants and sewerage systems, as well as the high levels of faecal contamination in public waters (16). The contamination of the waters of Guanabara Bay attracted international concern (16). The hosting of the 2016 Olympic Games prompted the government to launch a series of plans to restore the water quality of the bay. Not all plans have been fully implemented, but efforts to increase the capacity of wastewater treatment plants to meet targets agreed with the Olympic Committee, have increased the percentage of treated wastewater from 17 to 49% (16, 39). The (partial) restoration of Guanabara Bay and its shores could be one of the best legacies of the Rio de Janeiro Olympic Games.

During the Tokyo 2020 Olympic Games, the problem of inadequate retention capacity in the event of tropical rainfall led to significant amounts of untreated water being discharged into Tokyo Bay, resulting in biological contamination of the competition venues. Through monitoring, all stakeholders were able to significantly increase our knowledge and make an effective contribution to protecting the health of participants.

Healthy public waters are a particular concern for the Paris 2024 Olympic Games. Restoring the water quality of the Seine is a major environmental challenge that has been accelerated by

the Paris 2024 Games. To meet the sporting needs of Paris 2024, but also with a view to the legacy, many public players (local authorities, Seine stakeholders), under the leadership of the State and the City of Paris, have overseen the necessary work, including the commissioning of two treatment plants upstream from Paris and a water retention basin to prevent overflow of the sewage system (4).

The Olympic Games and international competitions cannot solve all water hygiene problems, but they can provide an important impetus for sustainable improvements in building structures and thus improve the water quality of public water supplies in the long term.

### Prophylaxis of Infections

Even before the COVID pandemic, the prevention of infectious diseases was an important issue at international sporting events, where masses of participants come together, often in improvised or unfamiliar conditions. Gastrointestinal diseases are a latent risk.

The 1920 Olympic Games in Antwerp were the first to be organized after the First World War and the Spanish flu pandemic (11).

Prior to the Athens 2004 Olympic Games, there was a mass outbreak of salmonella in a hotel during the preparatory competitions, from which much could be learned. During the Games, in which salmonellosis was a disturbing factor, about half of all gastroenteritis cases were reported through the mandatory reporting system (29).

In Brazil for the 2016 Olympics, a rapid epidemic of Zika was a health hazard for countries in the Americas. Consecutively, public phobia was raised as well as claims and counterclaims about the possible postponement or cancellation of the Games (15, 25).

Finally, the Tokyo 2020 and Beijing 2022 Winter Games faced significant challenges due to COVID-19. Sport organizations had to learn a lot. Effective control strategies were urgently needed to prevent SARS-CoV-2 virus transmission at global events (5, 33, 42).

Endemic viral diseases or pandemics, such as the Chikungunya or Zika virus before Rio or SARS-CoV-2 at the Tokyo 2020 Olympic Games, are a global challenge for any international sporting event, and especially for the largest and most universal, the Olympic Games (11, 33, 42) involving public suspicion and arousal (26), but also return-to-sports considerations (35). Prophylactic hygiene measures and considerable organizational efforts and cooperation between all those involved prevented the pandemic from spreading further and still enabled successful competitions (5, 26).

### Summary

The Olympic Games have an important role to play in addressing environmental, climate and public health issues. Of course, neither the International Federations, the NOCs and the IOC, nor the Organizing Committee, are research organizations or public health authorities (23). However, sport in general and the Olympic Games in particular can act as a catalyst for change and stimulate public investment, green travel, green environment, clean air and clean water, safe environment, recreation, physical activity and social support systems (23). All can have lasting effects on ecological systems, public health, physical activity and people's quality of life.

Recent Olympic Games have invested a lot of extra money in projects that have a lasting impact on the health of the host city. Paris 2024 wants to put physical activity and sport at the heart of its Games, with the aim of bringing more sport into people's lives. Sedentary lifestyles are now a major public health problem, with a significant impact on public finances due to the cost of treating diseases linked to obesity, cardiovascular disease, diabetes, various forms of cancer, etc. France Stratégie estimates the social cost of physical inactivity in France at around €140 billion per year (14), so it is worth taking advantage of events to reduce these costs.

In this respect, the Olympic Games have helped to change attitudes towards the climate crisis, the environment and natural resources over the past 50 years. While many people travel and consume resources to attend this global event, the impact of the Olympic Games on community development, health care, our natural resources and climate change justifies the effort. ■

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