



TECHNOLOGY INNOVATION AND GUARDRAILS IN SPORT

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BACKGROUND

- Wearables can be defined as small, lightweight devices worn on, close to, or even in the body where they monitor, analyse, transmit, and/or receive data from other devices and/or cloud services to provide biofeedback in real time to the user.¹⁻⁶
- Wearables are being used by a wide range of individuals engaged in activities of daily living or training and competing as amateur or professional athletes.¹
- Wearables are being developed that allow non-invasive or minimally invasive monitoring of a variety of physiological and biomechanical parameters, which in the past were simply not possible, or only measurable with sophisticated, time-consuming, and costly laboratory procedures.^{9,10}

THE CURRENT STATE OF THE ART

- One notable innovation in wearable technologies is the application of real-time monitoring at the Tokyo 2020 Olympic games comprising of a smartwatch application and ecosystem, designed to collect, process and transmit a wide range of physiological, biomechanical, bioenergetic and environmental data using cloud-based services.⁹ This represents the first concerted effort involving academic and industry partners to systematically implement wearable solutions to protect the health of athletes competing in major sporting events conducted in hot and humid environments such as the Olympic Games (i.e., Tokyo 2020, Paris 2024, LA 2028).
- Another related example is the non-invasive, in situ monitoring of sweating rate and sweat electrolyte losses via a skin-interfaced wearable microfluidic device with connected smartphone image processing platform that could enable in the near future real-time personalized fluid-electrolyte intake recommendations.¹⁰
- In professional rugby union, a device that incorporates Global Navigation Satellite Systems (GNSS), accelerometry, and gyroscope technology is now routinely fitted to the underside of each player's jersey between the shoulder blades allowing player movement to be recorded and reported live during match-play, providing team coaches with key performance "metrics" such as total distance covered by a player in match play, number of accelerations and decelerations, and "impact" during any given contact or tackle.¹⁹
- Some International Federations (IFs) promote the use of wearables in elite sport and in doing so encourage companies to develop these tools to facilitate high-level performance. For example, the Technical Rules 6.4.4 of World Athletics Federations (2022) on "assistance to athletes" allows "Heart rate or speed distance monitors or stride sensors or similar devices carried or worn personally by athletes during an event, provided that such device cannot be used to communicate with any other person."²⁰
- Despite the revolutionary potential of wearable devices, there are well-founded concerns including; ethical/data protection concerns; the lack of evidence for the beneficial effects of analysing specific parameters in a given context or in isolation; the quality of hardware and provided data; information overload; data security; and exaggerated marketing claims.^{7,11-13,15,16}

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FUTURE RECOMMENDATIONS AND DIRECTIONS

- Athletes will have the option to use an increasing number of wearables and each new device should add beneficial information to the training process with the goal of helping sports scientists and health care providers improve their athlete's or patient's performance and/or health.
- Some sporting rules and regulations will need to be altered to facilitate the use of some wearable devices.^{7,8} For example, UCI regulations on "Onboard Technology" (Chapter 3: Equipment) state that "Devices which capture other physiological data, including any metabolic values such as but not limited to glucose or lactate are not authorized in competition."¹⁸
- Sharing data and knowledge between the athletes, exercise scientists, hardware and software engineers, and other stakeholders also has the potential to improve wearable devices and technology for competitive athletes.
- Wearable devices that use biological data for health purposes ought to be required to undergo rigorous evaluation before being launched on the market, similar to the process pharmaceutical industries use to test their products.¹⁴
- Backing up the marketing claims of wearable technology developers with independent scientific evidence would positively impact sports, fitness, and the health market in general.¹⁴
- Wearable technology has the unique capacity to help characterize and understand performance at an individual level as well as to enhance the broadcast of sporting events with the relay of interesting performance-metrics and bio-metrics to the spectator.^{1,3,9}
- The field of sport and exercise science provides an excellent platform to understand the impact of wearable sensors on performance, wellness, health and disease.¹⁷

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