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Milano Cortina Living Lab: From Olympic Deployment to Global Athlete Intelligence AI-driven monitoring of athlete health and performance across Olympic cycles

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BACKGROUND + OBJECTIVE

Artificial intelligence and wearable technologies are transforming sport through real-time monitoring of physiological, biomechanical, and environmental responses. However, current approaches remain fragmented and frequently rely on single-sensor systems, limiting their ability to capture the complex and dynamic nature of athlete exposure in real-world competition (Muniz-Pardos et al., 2021). Research in Olympic and elite sport demonstrates that athlete health and performance are determined by the interaction of environmental conditions, biomechanical loading, and physiological responses. This requires integrated, multi-sensor systems capable of continuous operation in field settings (Racinais et al., 2023).

To develop and implement AI-driven, multi-sensor technologies for real-time monitoring of physiological, biomechanical, and environmental responses in elite athletes, enabling integrated understanding of athlete health, safety, and performance and supporting the development of predictive, athlete-centred monitoring systems. This work represents the early phase of a continuous Olympic research programme progressing from the National Games (2025) and Milano Cortina Olympic and Paralympic Games (2026) towards full implementation at the Los Angeles Olympic Games (2028).

IMPLEMENTATION PATHWAY

A structured, multi-event deployment pathway was designed to develop, test, and refine our integrated monitoring systems across diverse elite sport environments. The National Games of China (2025) provided an initial platform for implementation and validation and continued with the Milano Cortina Olympic Games (2026). We are now expanding to other major international competitions, including the Youth Olympic Games in Dakar (2026) and the World Cup Triathlon in Hong Kong (2026), enabling further evaluation across different climates, sporting disciplines, and logistical contexts. Subsequent deployments across additional global events will support continuous system refinement, scalability, and data integration.

Figure 2 — Global Implementation Pathway
Deployment trajectory across international events from National Games and Milano Cortina 2026 to Los Angeles 2028.

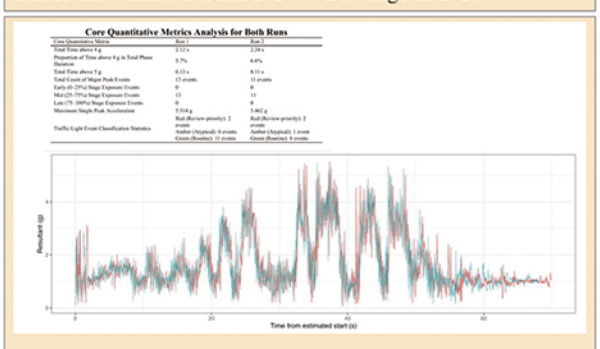

Figure 3 — Biomechanical Monitoring in Elite Sport
Example of continuous biomechanical data capture demonstrating structured athlete loading during high-performance competition (i.e., winter sliding sport - Luge).

MILANO CORTINA

Environmental monitoring across Olympic venues demonstrated substantial spatial and temporal variability, confirming that athletes compete within dynamic microclimates rather than uniform conditions (Racinais et al., 2023). Biomechanical monitoring revealed continuous and structured mechanical loading patterns in elite sport, including in non-contact disciplines. These findings demonstrate the feasibility of integrated monitoring at Olympic scale and identify areas for further development.

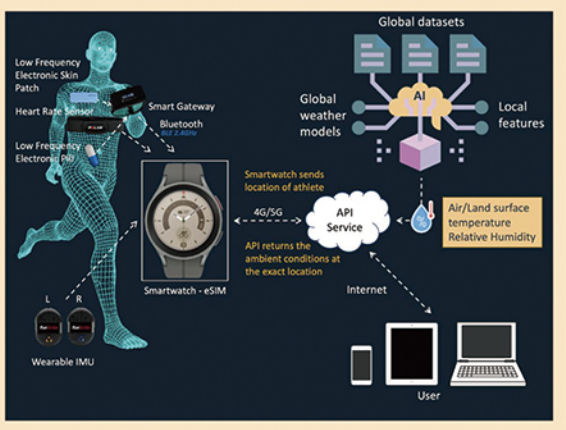

Figure 1 — Real-time Biometric Ecosystem
Integrated system combining wearable sensors, environmental monitoring, and AI-driven analytics for continuous athlete assessment.

EXTENSION ACROSS SPORTS

The system has been applied across multiple sport environments to establish generalisability. In endurance sport, integrated environmental and physiological monitoring during elite triathlon competition demonstrates the combined influence of heat stress and biomechanical load on performance (James et al., 2025). In combat sport, instrumented mouthguards quantify linear and rotational head acceleration, enabling objective assessment of repetitive head impact exposure (Yang et al., 2026). In indoor sport, in-shoe wearable sensors applied during elite basketball competition demonstrate preserved movement intensity and load across playing surfaces, despite increased deceleration demands and perceived slipping, without measurable reduction in performance. These findings demonstrate that athlete exposure is continuous, structured, and sport-specific across environments.

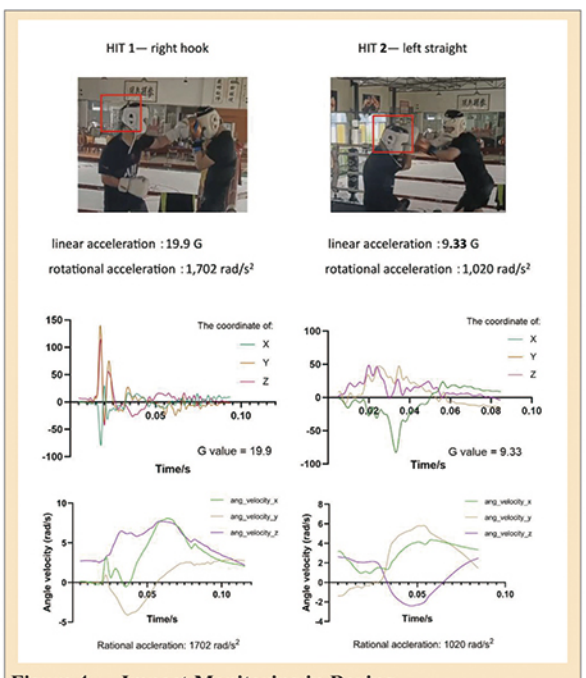

Figure 4 — Impact Monitoring in Boxing
Instrumented mouthguards capturing linear and rotational head acceleration during impacts, enabling objective quantification of repetitive head trauma exposure (Yang et al., 2026).

KEY INSIGHT

Athlete performance and safety emerge from the interaction of environmental, biomechanical, and physiological systems and cannot be understood through isolated measurements alone (Muniz-Pardos et al., 2021).

IOC QUOTE

"While it is too early to take individual decisions regarding a potential risk of exertional heat stroke based on portable technology alone… such technology may help better characterise overall risk associated with an event. However, individual use must be carefully regulated."
(Racinais et al., 2023)

This highlights the need for integrated, large-scale datasets combining multiple dimensions of athlete monitoring.

INTEGRATED SYSTEM

The project integrates wearable physiological sensors, biomechanical monitoring, environmental intelligence, and AI-driven analytics into a unified platform enabling continuous, real-time assessment of athlete health and performance in competition environments (Muniz-Pardos et al., 2021).

LIVING LAB

Following Milano Cortina, the project operates as a continuous living laboratory supporting longitudinal data collection, multi-sport validation, and progressive development of predictive models.

This represents an evolving system across Olympic cycles rather than a completed study.

IMPACT + FUTURE

This work supports athlete safety, performance optimisation, and evidence-based decision-making in elite sport. Ongoing deployments across Dakar, Hong Kong, and additional global events will expand datasets and refine predictive models toward full implementation at the Los Angeles Olympic Games 2028.

CONCLUSION

This project represents the early phase of a long-term Olympic research programme, advancing toward integrated, AI-driven systems capturing environmental, physiological, and biomechanical interactions in elite sport. Milano Cortina demonstrates real-world feasibility while highlighting the need for continued development. The next phase will expand to Dakar and Hong Kong, enabling further refinement across environments and sports.

This progression supports integrated datasets and predictive models, culminating in full-scale implementation at the Los Angeles Olympic Games 2028.

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