INTERNATIONAL GRADUATE COLLOQIUM

i-SPEAK 2025

SPORTS AND PHYSICAL EXERCISE ASSEMBLY OF KNOWLEDGE SHARING

COLLOQIUM PROCEEDINGS

EXTENDED ABSTRACT

Evaluating AI and Traditional Models for Injury Prediction and Prevention in High-Contact Sports

Muhammad Fikruzzaman[1], Razif Sazali[1], Yusandra Md Yusoff[1], Muhammad Zulqarnain[1], Amrun Haziq[1], Aizzat Adnan[1], & Adam Linoby[1*]

[1]*Faculty of Sports Science and Recreation, Universiti Teknologi MARA, Negeri Sembilan Branch, Seremban Campus, Negeri Sembilan, MALAYSIA*

**Corresponding author: linoby@uitm.edu.my*

Keywords: *Sports injury prediction, Artificial intelligence, Machine learning models, Injury prevention, High-contact sports*

I. Introduction

Artificial intelligence (AI) holds promise in transforming sports injury prediction and prevention. However, the integration of AI into high-contact sports contexts remains methodologically fragmented [1]. This systematic review and meta-analysis investigate prevailing AI definitions, model types, predictive accuracy [2], and preventive applications compared to traditional methods, addressing critical gaps in model quality, interpretability, and utility for risk factor identification in sports medicine [3].

II. Methods

This systematic review followed a prospectively registered protocol in PROSPERO (ID: 611050), adhering strictly to PRISMA 2020 guidelines. Comprehensive database searches (PubMed, Web of Science, Scopus, OVID-MEDLINE) employed structured searches guided by the PICO framework to identify relevant studies published until January 2025.

Eligible studies included prospective cohort or observational designs involving athletes in high-contact sports. Studies compared machine learning-based predictive models with traditional injury-prediction methods and reported injury incidence, type, and recovery outcomes.

Data extraction involved demographic, training load, injury, and performance metrics. Quantitative analyses assessed model accuracy and robustness, while qualitative synthesis provided deeper insight into predictive performance and individualized injury risk identification.

III. Results and Discussion

A. Study Characteristics and Populations

The systematic review included 10 studies from six different countries, with Australia contributing the most studies. A total of 3,179 subjects participated, comprising young adult athletes involved in high-contact sports. Participants had a mean age of 23.7 years (*median* = 22.7; *range* = 20–28.8). The studies were short-term, uniformly lasting approximately nine days. Recruitment predominantly occurred from sports clubs and teams during pre-season evaluations.

B. Pooled Treatment Effects

Pooled analyses demonstrated that machine learning-based predictive models were more effective compared to traditional methods for reducing injury incidence among athletes in high-contact sports. Machine learning models such as Random Forests, XGBoost, and ADTree showed superior predictive accuracy, achieving AUC values ranging from 0.76 to 0.88. Specifically, SmoteBoost with ADTree yielded high accuracy for predicting hamstring (AUC = 0.837) and lower extremity injuries (AUC = 0.747). In contrast, traditional models generally produced less consistent results due to limited capacity for handling complex interactions among injury risk factors.

C. Subgroup Analysis by Treatment Duration

Subgroup analysis based on treatment duration indicated that shorter interventions, specifically pre-season or immediate short-term evaluations (approximately nine days), demonstrated consistent effectiveness of machine learning models in predicting and potentially reducing injury risk. However, due to the absence of longer-term intervention data, the sustained effectiveness of these models over extended periods remains uncertain. Future research with prolonged monitoring is recommended to establish long-term efficacy and durability of injury prevention through these predictive approaches.

Fig. 1 Map showing the geographic origin of the 10 studies included in this

systematic review. Colour intensity reflects the number of studies per country (scale 1–4).

TABLE I
SUBJECT CHARACTERISTICS

Characteristic	Mean	Median	Min	Max
Age (*yrs*)	23.7	22.7	20.0	28.8
Study Duration (*days*)	9	9	9	9

Fig. 2 shows the study design distribution for included studies.

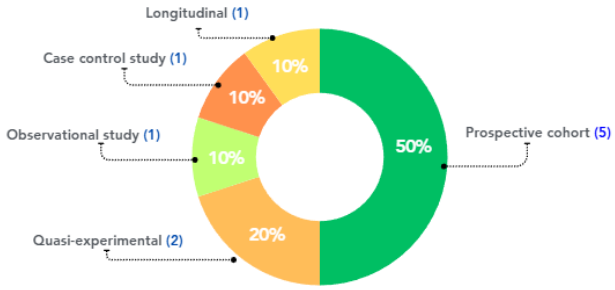

Fig. 2 A donut chart in green, apple green, yellow, lime, and orange differentiates Prospective cohort, Longitudinal, and Case control study, Quasi-experimental, and Quasi-experimental.

IV. CONCLUSIONS

AI-based models outperform traditional methods in predicting and preventing sports injuries, particularly in high-contact sports. Despite interpretability and generalizability challenges, ensemble and hybrid techniques show strong potential for real-time, personalized risk management. Standardized reporting and broader validation are essential for clinical translation and integration into sports injury prevention protocols.

ACKNOWLEDGEMENTS

The authors thank Adam Linoby, collaborators, and Universiti Teknologi MARA for their invaluable support, data analysis, and contributions to the thesis and literature review.

REFERENCES

[1] Van Eetvelde, H., Mendonça, L. D., Ley, C., Seil, R., & Tischer, T. (2021). Machine learning methods in sport injury prediction and prevention: a systematic review. *Journal of Experimental Orthopaedics*, 8, Article 27. https://doi.org/10.1186/s40634-021-00346-x.

[2] Musat, C. L., Mereuța, C., Nechiță, A., Tutunaru, D., Voipan, A. E., Voipan, D., … Nechiță, L. C. (2024). Diagnostic applications of AI in sports: A comprehensive review of injury risk prediction methods. *Diagnostics*, 14(22), 2516. https://doi.org/10.3390/diagnostics14222516.

[3] Pietraszewski, P., Terbalyan, A., Roczniok, R., Maszczyk, A., Ornowski, K., Manilewska, D., Kuliś, S., Zając, A., & Gołaś, A. (2025). The role of artificial intelligence in sports analytics: a systematic review and meta-analysis of performance trends. *Applied Sciences*, 15(13), 7254. https://doi.org/10.3390/app15137254.