Development of a standardised method for the analysis of mechanisms and circumstances of injury in football

Francesco Aiello1,2

1 Arsenal Performance and Research Team, Arsenal Football Club, London, UK

2 School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK

Corresponding to Dr Francesco Aiello, School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK; F.Aiello@napier.ac.uk

**What did I do?**

The aim of this project was to develop a new standardised system to classify and analyse the circumstances of injuries (commonly referred to as injury mechanisms) in football.

A systematic review was conducted to investigate the literature on the topic and aimed to evaluate how the injury circumstances had been analysed and reported.1 The information obtained through the systematic review was used to inform the first stage of the second study, which aimed to develop of a new standardised system to classify injury inciting circumstances in footbal.2 A third study was subsequently conducted to evaluate the usability of this system in football setting and to analyse the injury circumstances leading to non-contact injuries in elite football players.3

**Why did I do it?**

Understanding how injuries occur (i.e., injury circumstances) is essential for the development of injury prevention strategies.4 Studies that aimed to investigate the injury circumstances in football have used different classification systems and terminology, which makes the understanding of the injury circumstances and the comparison between studies difficult. Additionally, despite it is believed that certain injuries (e.g., hamstring, rectus femoris) occur while players run at high speeds, 5-7 players’ running speeds had not been investigated before using objective measures such as Global Positioning System (GPS) or optical-video analysis, therefore this information could not be accurate.

**How did I do it?**

The thesis consisted of three studies. The first study was a systematic review which aimed to investigate how injury circumstances had been analysed and reported in the literature.1 Subsequently, 10 practitioners and researchers with more than 5 years of experience working in professional football and/or conducting injury research were involved in a consensus study which aimed to develop a standardised classification system for injury inciting circumstances.2 Once the system was developed, a retrospective study was conducted to evaluate whether the system is usable in a football setting and whether injuries occur during high-speed runs.3 Medical data, together with GPS tracking data and video collected over three seasons by an elite football club were analysed to evaluate the injury inciting circumstances which included an objective analysis of the speed at which players were running when the injuries occurred.

**What did I find?**

From the systematic review it resulted that duels and unspecified activities accounted for the highest proportion of injury-inciting circumstances in general. High-intensity running and kicking activities seemed to be the main inciting activities of thigh and groin injuries, while duels seemed to be the most common inciting activities of ankle injuries. Duel activities and pressing resulted to be the most common inciting activities leading to anterior cruciate ligament injuries, but there was not complete agreement within the literature. The most important finding of this study was that injury inciting circumstances were reported using arbitrary and heterogeneous classification systems. Another interesting finding was that the number of studies that used video-analysis has been increasing in the past 10 years.

The second study led to the development of the Football Injury Inciting Circumstances Classification System (FIICCS), a new standardized system to collect injury inciting circumstances, which has been included in guidelines for the recording and reporting of injury data in football.8 The FIICCS includes five domains: contact type, running activity, ball situation, session details and contextual information (Figure 1) and is also split into a core outcome set (essential reporting) and an optional set (additional details). The panel deemed the system to be easy to use in both practical and research settings.

Insert Figure 1 here

The third study showed that combining video and GPS data to analyse inciting circumstances is feasible and can provide insightful information. Indeed, from the analysis it resulted that most non-contact hamstring injuries occurred when players covered a median distance of 16.7m while running achieving a median peak speed of 29.3 km/h, corresponding to 87.6% of players maximal running speed. Considering only hamstring injuries which occurred while players were accelerating players ran for 23.9 m and achieved a median peak speed of 27.6 km/h which corresponded to 83% of their maximal speed.

**What is the most important clinical impact / practical application?**

This project developed a system for collecting, analysing, and reporting in an accurate and standardised manner data on injury inciting circumstance. Hopefully, this will contribute to improve the accuracy and standardisation of future research and will be included in routine data collection procedures within football clubs. This will provide important information for the development of training programmes, injury prevention strategies, and potentially return to play protocols.

**Twitter:** @Fr\_Aiello

**Acknowledgements:** I wish to thank my supervisors Dr. Susan J. Brown, Dr. Alan McCall, and Prof. Franco M. Impellizzeri for their guidance and support over this journey. I also wish to thank all the co-authors that contributed to these projects. A final thank to Arsenal FC and Edinburgh Napier University for funding this PhD.

**Contributors:** FA completed this work as part of his PhD, which was supervised by Dr. Susan J. Brown, Dr. Alan McCall, and Prof. Franco M. Impellizzeri. Other researchers collaborated in the studies, for which they are credited as co-authors.

**Funding:** This PhD was funded by Arsenal FC and Edinburgh Napier University.

**Competing interests:** None to declare

**Ethics approval:** The studies conducted during this project have been approved by Edinburgh Napier University Research Integrity Committee (SAS/2786536 and SAS/2773451)

**ORCID:** 0000-0002-4953-106X

**References**

1. Aiello F, Impellizzeri FM, Brown SJ, et al. Injury-inciting activities in male and female football players: a systematic review. *Sports Medicine* 2023;53(1):151-76. doi: 10.1007/s40279-022-01753-5

2. Aiello F, McCall A, Brown SJ, et al. Development of a standardised system to classify injury-inciting circumstances in football: the Football Injury Inciting Circumstances Classification System (FIICCS). *Sports Medicine* 2023 doi: 10.1007/s40279-023-01857-6

3. Aiello F, Di Claudio C, Fanchini M, et al. Do non-contact injuries occur during high-speed running in elite football? Preliminary results from a new GPS and video-based method. *Journal of Science and Medicine in Sport* 2023 doi: <https://doi.org/10.1016/j.jsams.2023.07.007>

4. O’Brien J, Finch CF, Pruna R, et al. A new model for injury prevention in team sports: the Team-sport Injury Prevention (TIP) cycle. *Science and Medicine in Football* 2019;3(1):77-80. doi: 10.1080/24733938.2018.1512752

5. Geiss Santos RC, Van Hellemnondt F, Yamashiro E, et al. Association between injury mechanisms and magnetic resonance imaging findings in rectus femoris injuries in 105 professional football players. Clinical Journal of Sport Medicine 2022;32(4):e430-e35. doi: 10.1097/jsm.0000000000000935 [published Online First: 20210526]

6. Liu Y, Sun Y, Zhu W, et al. The late swing and early stance of sprinting are most hazardous for hamstring injuries. *Journal of sport and health science* 2017;6(2):133-36. doi: 10.1016/j.jshs.2017.01.011 [published Online First: 2017/06/01]

7. Yu B, Liu H, Garrett WE. Mechanism of hamstring muscle strain injury in sprinting. *Journal of Sport and Health Science* 2017;6(2):130-32. doi: <https://doi.org/10.1016/j.jshs.2017.02.002>

8. Waldén M, Mountjoy M, McCall A, et al. Football-specific extension of the IOC consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020. *British Journal of Sports Medicine* 2023:bjsports-2022-106405. doi: 10.1136/bjsports-2022-106405

Figure legend:

Figure 1 Structure of the Football Injury Inciting Circumstances Classification System2