

Epidemiology of injuries at the 2023 UCI cycling world championships using the International Olympic Consensus: a protocol for a prospective cohort study

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ABSTRACT

The sport of cycling consists of several individual sporting disciplines. Indeed, the world governing body for cycling, Union Cycliste Internationale (UCI), oversees the various cycling disciplines, with each of these disciplines having a number of subcategories. While several sports have undertaken prospective injury surveillance studies to understand the risks of their sport, plan event medical support and develop prevention programmes, limited high-quality studies have been undertaken within cycling. Indeed, this is the first prospective study of cycling injuries, particularly when considering the whole sport of cycling together. This current study will therefore aim to describe the incidence, severity, burden and nature of injuries within elite cycling in those athletes participating across 13 championship events at the inaugural World Championships, Glasgow, August 2023. Injury and exposure definitions will be in line with the IOC Consensus for injury surveillance in cycling. Injury incidence will be reported per 1000 athlete match hours or per number of athletes/cyclists and injury severity will be assessed via estimated median or mean days lost to training/competition. Meanwhile injury burden will be assessed via days of absence/1000 athlete match hours (or per number of athletes exposed) and all these results will be compared between male and female cyclists. This paper will also report the most common specific injuries for male and female cyclists (per 1000 hours of participation or per number of athletes exposed). Statistical differences will be tested for incidence or severity measures between sexes and will be compared to other sports.

INTRODUCTION

Cycling is an incredibly popular sport, recreational activity and mode of transport, with an estimated one billion bikes worldwide in 2019.¹ The sport of cycling consists of several individual sporting disciplines. The world governing body for cycling, Union Cycliste Internationale (UCI), oversees the cycling disciplines of road cycling, cyclocross, mountain bike (MTB), trail, gravel, BMX freestyle, BMX racing, track, e-sport, para-cycling and indoor. Each of these disciplines has several

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Cycling consists of multiple disciplines. Indeed, the world governing body for cycling, Union Cycliste Internationale, oversees the cycling disciplines of road cycling, cyclocross, mountain bike, BMX freestyle, BMX racing, track, indoor and paracycling and each of these disciplines has several subcategories of cycling activities.
- ⇒ The different sports of cycling would appear to be high risk for injuries, but limited prospective injury/illness surveillance studies are undertaken in these sports.

WHAT THIS STUDY ADDS

- ⇒ This is the first prospective study of cycling injuries, particularly when considering the whole sport of cycling together. Therefore, this study will describe the incidence, severity, burden and nature of injuries within elite cycling in athletes participating across 13 championship events at the inaugural World Championships, Glasgow, August 2023.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ This study describes the protocol for prospective injury reporting across the different cycling disciplines, using injury and exposure definitions in line with the IOC Consensus for injury surveillance in cycling. Thus, any future injury-reporting studies in cycling will use this protocol to help guide their studies.

subcategories of cycling activities. Thus, cycling is an umbrella term for several individual sporting disciplines. The scientific evidence suggests that undertaking regular cycling activities is associated with general health and well-being benefits and is encouraged within the United Kingdom (UK) Chief Medical Officers' guidelines for physical activity promotion in the general population as well as the comparable guidelines in the USA.²⁻⁸



While the health benefits of participating in cycling activities are clear, athletes, particularly professionals at the elite end of the spectrum, can develop injuries and illnesses related to their cycling activities. These can interfere with their ability to train and compete as individuals and as a team.^{8,9} In the first systematic review of road cycling injuries, skin abrasions, lacerations and haematomas were the most common injuries identified, followed by fractures (the most common fracture being the clavicle), concussions and musculotendinous injuries.⁹ The upper limb was more commonly affected than the lower limb.⁹ Furthermore, this review highlighted the lack of prospective injury surveillance studies within cycling and the inconsistent methods employed to measure the injuries.⁹ However, of the prospective injury surveillance studies in cycling that have been done, none have documented and compared injuries and illness in all the cycling disciplines, including paracycling, using the latest IOC Consensus statement on epidemiology reporting in sport, including the extension for reporting injuries and illness in cycling.⁸⁻¹⁴ Thus, there is a clear need for a study comparing injury rates in the different cycling disciplines using consistent, reproducible and comparable methods.^{9-11 13-15} Understanding the injury risks allows risk mitigation strategies to be put into place and thus allow cyclists and their teams to achieve the highest level of performance and protect their health. Furthermore, this prospective study will help medical staff and event organisers plan and optimise healthcare provision and, more importantly, develop prevention measures according to the diagnoses and risk profile of the respective event and athlete population.

Using the methods outlined in the consensus on reporting and recording injury in cycling, this study will record injuries in all cyclists competing at the inaugural UCI World Championships in Glasgow, 2023. The prospective cohort study will aim to identify and compare the injury characteristics and burden between the different cycling disciplines throughout the UCI World Championships, Glasgow, 2023, and compare the injury burden between female, male and paracyclists as well as to identify similarities and differences between these participants. The primary aim of this paper is to describe and detail the methods for this novel surveillance study in recording injuries across multiple cycling disciplines.

METHODS

The participants of this prospective, observational study will be recruited from those elite cyclists competing at the UCI World Championships in Glasgow, 2023. They will follow the injury reporting guidelines established by the IOC, including STROBE-SIIS, the cycling-specific extension and para-sport translation of these guidelines.^{10 12 13 15 16} Ethical approval for this study has been granted by the Medical Faculty, Queen's University Belfast, Northern Ireland (Faculty REC Reference Number MHLS 23_97).

Implementation

The event medical teams covering all the cycling disciplines at the World Championships were advised and educated on the study. All medical teams at the event will receive information about the study's objectives, methodology and inclusion criteria. All medical teams will be advised to document all injuries at the Championship with the Injury Reporting Form (online supplemental appendix 1), developed from the consensus on reporting and recording injuries in cycling.¹²

That is, the date of injury, estimated date of return-to-play/training, recurrence, cycling discipline, injury cause, mechanism of injury, injury location and injury type, classified by the Orchard Sports Injury Classification System (OSICS) version 10, will be recorded by all the event medical support at the World Championships.¹⁶ Venue medical teams will complete the data form (online supplemental appendix 1) at all the sites throughout the World Championships, including at the events in Glasgow and the downhill mountain biking at the Nevis range in Fort William, among others. The event medical teams should complete all injury forms daily and return them to the Chief Medical Officer (CMO) for the event (NE) on the same day. If anyone objects to their data being recorded in this way, the medical teams caring for the athlete in question should notify the event CMO. The data will be screened for duplicates daily, and any incomplete or unclear data will be queried with the named person completing the form to allow full data capture for the study period. All the cyclists will be notified of the study by the event medical staff caring for them and advised that if they object to their anonymised medical information being shared, they are free to do this, and their medical information will not be shared with the researchers.

Data collection, inclusion and exclusion criteria

The questionnaire (online supplemental appendix 1) will be created using a Qualtrics survey-based application. All athletes who experience an injury at the World Championships and seek medical attention for this will be eligible for the study. The inclusion criteria were male or female cyclists with no age restriction competing at the World Championships.

Injury exposure will be calculated by the number of athletes/cyclists competing in each cycling discipline and the hours of exposure to each cycling discipline (where available). The hours of exposure in each cycling discipline will be calculated, where possible, by multiplying the number of competitors by the duration of the event.

Descriptive and statistical analysis

All data will be processed on a Macintosh computer using Microsoft Office and SPSS (V.28). Methods to be applied will include frequencies (%), crosstabs, descriptive and means/medians. All cyclists will be analysed together, and then the different cycling disciplines (road cycling, cyclo-cross, MTB, BMX freestyle, BMX racing, track, indoor

and paracycling) will be analysed separately to allow comparison of injury data between the disciplines. This injury data will then be reported as totals, males, females and level of participation (amateur vs professional), allowing comparison between these groups of athletes. Differences between categorical data, for example, cycling disciplines, sexes and para-athletes, will then be compared by χ^2 tests. Continuous data, for example, age, will be compared by simple t-tests. All statistical tests will be two-sided, and results with $p < 0.05$ will be considered statistically significant.

Study sample

We will describe the sample by sex and age distribution, Para athletes' level of disability/impairment using UCI classification, and the cycling discipline they were competing in. We will additionally describe the country they represent (unless this would potentially identify them due to low competing numbers in their event) and the level they are competing at (amateur or professional). We will then describe the different injuries (body region, organ affected and side of body affected) experienced by the cyclists and report this as x/athletes competing and y/hours of exposure, with 95% CIs possible. Injury data will also be described by able-bodied versus paralympic athletes, with relevant comparisons made.

DISCUSSION

This will be the first multidiscipline prospective injury study within cycling, reporting as per the IOC guidelines. The data insights generated through this study will be used to understand the risks of the different cycling sports and disciplines, plan event medical support, and develop prevention programmes.

Although cycling participation increases overall health and well-being, this study will seek to understand the common injuries experienced by elite cyclists in the different disciplines, including identifying the ones that stop participation. The study will include amateur and professional cyclists and paracyclists competing at the highest level of their sport, the World Championships. The identification of the common injuries will then allow better treatments to be targeted at cycling events and potentially be able to identify ways to prevent these injuries and thus maintain participation.

The common injuries previously identified in the different cycling disciplines include shoulder girdle, hand and lower arm, neck, head, lower back, hip, knee and calf/Achilles.^{8,9,11,14} Additionally, within road cycling, the type of injury appears to be more acute in abrasions/lacerations and haematomas, with lower incidences of muscle/ligament/tenon injuries accounting for over 30% of the injuries.^{8,9} At the Tokyo Olympics 2020, BMX racing and BMX freestyle were the second and third-highest injury-incident sports.¹¹ Despite differences in cycling disciplines and sporting demands, injury locations within both BMX disciplines were comparable to road and track cycling.¹¹ While in road cycling, injuries

are more common in the upper limb, rugby reports that injuries are more common in the lower limb.^{9,17} Meanwhile, concussion is reported to be the most common injury in both male and female rugby, which is similar to a prospective research study within enduro mountain biking.^{9,14,17} However, road cycling reports that concussion is the third the most common type of injury, highlighting the spectrum of injury locations relative to individual sporting disciplines in cycling.^{9,14,17}

Within paracycling, there is limited prospective research on injury prevalence.^{13,18} Recent studies have highlighted injury incidences from 9% to 17% in road and track paracycling.^{18,19} From the injury and illness statistics, 71%–75% were sudden onset compared with 17%–25% being gradual onset.^{18,19} Additionally, para-athletes may have underlying medical conditions that place them at higher illness risk. Knowing this information across cycling disciplines, for the different sexes, different levels of performance and between able-bodied and paralympic competitors will allow risk mitigation and medical planning to be implemented.

LIMITATIONS

The study will be a high-quality, prospective injury epidemiology study, reported as per current best practice, the IOC STROBE-SIIS guidelines.¹⁰ However, this study will only include injuries reported to the event medical staff for medical attention. Thus, the reported injury rate is likely lower than if self-reported measures were used and if we included team medical contacts. Additionally, chronic conditions are less likely to be reported within this study because these conditions will likely mean that the cyclist is not competing at the event and, therefore, as described by previous authors, is a limitation of tournament injury/illness reporting studies.¹⁵

CONCLUSION

This is the first prospective injury reporting study across the different cycling disciplines and will be undertaken at the UCI World Championships in Glasgow, Scotland, in 2023. The study data will be used to understand the risks of the different cycling sports and disciplines, plan event medical support and develop prevention programmes. We will additionally be able to compare data across the different sexes of cyclists and between able-bodied and para-athletes, which will allow targeted prevention and medical support for the different cycling events.

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REFERENCES

- Jones D. How many bicycles are there in the world? Discerning Cyclist; 2022. Available: <https://discerningcyclist.com/how-many-bicycles-in-world/>
- Oja P, Titze S, Bauman A, *et al.* Health benefits of cycling: a systematic review. *Scandinavian Med Sci Sports* 2011;21:496–509.
- Nordengen S, Andersen LB, Solbraa AK, *et al.* Cycling is associated with a lower incidence of cardiovascular diseases and death: part 1 – systematic review of cohort studies with meta-analysis. *Br J Sports Med* 2019;53:870–8.
- Nordengen S, Andersen LB, Solbraa AK, *et al.* Cycling and cardiovascular disease risk factors including body composition, blood lipids and cardiorespiratory fitness analysed as continuous variables: part 2 – systematic review with meta-analysis. *Br J Sports Med* 2019;53:879–85.
- UK Government. Physical activity guidelines for adults (19–64 years). 2011. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833126/dh_128145.pdf
- Leyland L-A, Spencer B, Beale N, *et al.* The effect of cycling on cognitive function and well-being in older adults. *PLOS ONE* 2019;14:e0211779.
- CDC. Move more; sit less. Centers for Disease Control and Prevention; 2020. Available: <https://www.cdc.gov/physicalactivity/basics/adults/index.htm#:~:text=Physical%20activity%20is%20anything%20that>
- Edler C, Droste J-N, Anemüller R, *et al.* Injuries in elite road cyclists during competition in one UCI worldtour season: a prospective epidemiological study of incidence and injury burden. *Phys Sportsmed* 2023;51:129–38.
- Rooney D, Sarriegui I, Heron N. “As easy as riding a bike”: a systematic review of injuries and illness in road cycling. *BMJ Open Sport Exerc Med* 2020;6:e000840.
- Bahr R, Clarsen B, Derman W, *et al.* International olympic committee consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sports 2020 (including the STROBE extension for sports injury and illness surveillance (STROBE-SIIS)). *Orthop J Sports Med* 2020;8:2325967120902908.
- Soligard T, Palmer D, Steffen K, *et al.* New sports, COVID-19 and the heat: sports injuries and illnesses in the Tokyo 2020 summer Olympics. *Br J Sports Med* 2023;57:46–54.
- Clarsen B, Pluim BM, Moreno-Pérez V, *et al.* Methods for epidemiological studies in competitive cycling: an extension of the IOC consensus statement on methods for recording and reporting of Epidemiological data on injury and illness in sport 2020. *Br J Sports Med* 2021;55:1262–9.
- Derman W, Badenhorst M, Blauwet C, *et al.* Para sport translation of the IOC consensus on recording and reporting of data for injury and illness in sport. *Br J Sports Med* 2021;55:1068–76.
- Palmer D, Florida-James G, Ball C. Enduro world series (EWS) mountain biking injuries: a 2-year prospective study of 2010 riders. *Int J Sports Med* 2021;42:1012–8.
- Heron N, Sarriegui I, Jones N, *et al.* International consensus statement on injury and illness reporting in professional road Cycling. *Phys Sportsmed* 2021;49:130–6.
- Orchard JW, Meeuwisse W, Derman W, *et al.* Sport medicine diagnostic coding system (SMDCS) and the orchard sports injury and illness classification system (OSIICS): revised 2020 consensus versions. *Br J Sports Med* 2020;54:397–401.
- Bailey SJ, Martindale R, Engebretsen L, *et al.* Epidemiology of international match injuries in Scottish Rugby: a prospective cohort study. *Int J Sports Med* 2023;44:805–12.
- Willick SE, Webbhorn N, Emery C, *et al.* The epidemiology of injuries at the London 2012 paralympic games. *Br J Sports Med* 2013;47:426–32.
- Luijten SCM, te Loo LM, Nauta J, *et al.* n.d. Sports-related health problems in para-sports: a systematic review with quality assessment. *Sports Health*.