**International consensus statement on injury and illness reporting in professional road cycling**

**Main author:**

**Keywords** (up to five): consensus statement; injury and illness reporting; road cycling; incidence; prevalence.

**Abstract**

**Introduction**

Road cycling is a very common recreational and elite sport. To facilitate consistent reporting of injuries and illness in professional road cycling we want to establish terms, definitions and methods for injury and illness reporting in elite road cycling epidemiology studies, similar to other sports.

**Aims/Objectives**

The aim of this study is to establish an international expert statement for injury and illness reporting in professional road cycling.

**Methods**

We initially conducted a literature review of the injury and illness epidemiology studies in sport and identified popular terms, definitions and methods which could be applied to road cycling. These terms were then reviewed by our expert panel, with clarification of terms and definitions and additional terms added, if required. The final consensus statement was then agreed by all authors.

**Results**

The relevant definitions for use in professional road cycling epidemiology studies have been agreed. Injury rates should be reported as per 1,000 hours of cycling training, both in and outdoors, and per 1,000 hours of competition as well as per 1,000 hours of non-cycling training.

**Discussion**

We encourage authors to use this expert paper when undertaking injury and illness epidemiology studies in professional road cycling to increase the rigor of the studies as well as allowing comparability between different road cycling studies and epidemiology studies in other sports.

**Endorsements**

This consensus statement has been endorsed by the world governing body for cycling, the UCI.

**What is already known**

* Other sports, including cricket, football and rugby, have published consensus statements for injury and illness reporting in their respective sports.
* Professional road cycling does not currently have an injury and illness expert statement for reporting injuries and illness.
* An expert statement around injury and illness reporting in sports facilitates consistent reporting of injuries and from this data, then allows development of injury and illness prevention programmes and monitoring the implementation of prevention programmes.

**What this study adds**

* This paper is the first expert statement for injury and illness reporting in professional road cycling.
* We hope that this expert statement is adopted by researchers in the field of road cycling injury/illness epidemiology studies and can be improved and updated as studies are published in this area.

**Introduction**

Injury and illness prevention is a major goal for sport medicine and science in order to maximise the athletes’ safe availability for competition. The first part of injury prevention (1)(2) is to understand the size of the problem. Expert statements, with agreed definitions of injuries and illness as well as consistent methodology for reporting these studies, allow accurate illness and injury data collection. Uniform collection of data for injury epidemiology studies will then allow comparisons between road cycling teams as well as comparisons to and learning from other sports. Additionally, rigorous reporting of illness and injury will inform illness and injury prevention strategies, ensuring safer participation in elite road cycling events, helping protect the health of cyclists.

**Cycling injury studies to date**

Few injury studies have been undertaken in road cycling and the ones that have, have generally been of poor quality and used varying methodology. Indeed the paper by Haeberle et al (3) describes acute cycling injuries in the Tour de France over 8 years using media documented injuries and illness and is therefore open to reporting bias. Whilst the paper by Decock et al (4) used a retrospective analysis of injury reporting forms from the medical teams at non-professional road cycling races in Flanders, Belgium in the years 2002 and 2012. The different methodologies used in these studies, highlights the need for a consistent reporting of injuries and illness in road cycling. Our aim was therefore to establish an expert group of road cycling health professionals and agree an international expert statement on a set of standardised definitions of medical injuries and illness encounters (ie, incidents, complications) and a standardised methodology to record and report medical encounters within, primarily, elite road cycling.

**Methods**

This paper builds on the recently published STROBE-SIIS (5), making the terms specific to road cycling. Rather than repeat similar terms, we have only included terms in this paper that have been modified or are unique for the professional road cycling discipline. Thus this consensus paper should be used in combination with STROBE-SIIS (5).

The lead author (NH) initially reviewed the literature on injury and illness surveillance in sport, identifying common terms that could be adopted for use in road cycling from other sports. The literature review particularly focused on the previous consensus statements published from other sports (6) (7) (8)(9) (10) (11) (12)(13) (14) (15) (5). Additional definitions were then included from this initial literature search and were then discussed with RN and the other consensus group authors, NJ and IS, utilising the researchers experience in providing medical care to elite road cyclists and events (all authors have been involved in medical provision to elite world tour road cyclists during their careers). Once an initial set of terms and definitions were agreed between NH and RN, these were then again circulated to the group of elite sport medicine physicians working at the World Tour level of road cycling (NJ, IS). This feedback was then collated and a further draft of the statement provided to the group to comment on and following this, the final terms and definitions were agreed. There was no funding to allow for face-to-face meetings and therefore the whole expert statement process was conducted via emails and telephone conversations. In this document, the word ‘injury’ is consistent with either an illness or injury.

**Results**

1. **Road cycling competitions and training**

Race competitions for riders are clearly defined in road cycling as organised, scheduled events and there is a clear demarcation between competitions and training. Competitions can involve criteriums, one-day stage races, multi-stage races (typically up to 7 days long) and then the Grand Tours, which run for 3 weeks and consist of 21 stages typically. Within these races, you also have time trial (TT) events, which can either involve an individual or a team (team time trialing, TTT) trying to produce the fastest time over a given course and distance. For criteriums, the riders do a specified number of laps of a circuit. In a stage race, the days can also be split, with a morning race and then an afternoon race, which still counts as one stage or day of racing. For example, a road race in the morning with a time trial in the afternoon. If a rider experiences an injury, then the type of race competition which the rider was undertaking at the time of competition should be documented. If the injury occurred in training, then this should also be documented, including differentiating between on-bike training and off-bike training, e.g. strength training in a gymnasium. For each cohort being studied, it should be clearly stated for each rider the number of hours of competition, the number of hours of on-bike training and the number of off-bike training undertaken during the specified time period under study.

1. **Characterisation of the riders’ role in the team**

In terms of elite road cycling, there are different riders within the peloton who have specific qualities. We would suggest using the terms rouleur, general classification (GC) contender, domestique, all rounder, sprinter and climber/high mountain support, allowing us to identify if certain injury/illness patterns are unique to certain types of riders. Rouleur is a rider who is capable of riding at the front of his team or peloton, providing a fairly consistent road pace on the flat terrain and typically excel in the one-day ‘Classic’ races. They are generally the ‘engine room’ of road cycling teams as well as being potentially capable of competing for the win in mostly flat, one-day stages or races. Sprinters are riders who are capable of producing a sprint/fast finish at the end of a mostly flat stage. Whilst a climber/high mountain support rider is someone who is adept at riding on steep inclines, typically at high altitudes. Meanwhile a GC contender is a rider who is contending for the overall win throughout a multi-stage race. They are capable of doing most road cycling disciplines well, including climbing, rolling fast on a flat stage and time trialing. Similarly, ‘all rounders’ can perform well on most terrains (flat and high-mountain stages) but are just not quite at the same level as the GC contender. Finally, all GC contenders need ‘domestiques’ who are in the team to look after them, for example, collecting fluid and food from support cars and bringing it to them. Domestiques are not in the team to win themselves but are working to get the team and/or their GC contender the win.

1. **Time frames of the road cycling season**

The typical professional road cycling season runs from January to October of each year, with typical ‘pre-season’ training taking place between the middle to end of November until the end of December. Traditionally the professional World Tour season starts at the beginning of January with the Tour Down Under in Adelaide, Australia. However, many road cyclists are now participating in other cycling disciplines and it is not uncommon for road cyclists to participate in cyclo-cross competitions in December and January. If a road cyclist does sustain an injury whilst undertaking other cycling disciplines then this should be included in the overall write up of the epidemiology study as a ‘training injury’, with a clear explanation. As the season is extending for road cyclists, we would suggest calculating ‘annual’ rates of illness/injury as opposed to ‘seasonal’ rates. An ideal start date for annual surveillance studies is the first of November each year, allowing the assessment of pre-season training on injury risk before the season starts in January. Although if a different start date is chosen for practical purposes, this should be specified and justified in the research methods. Indeed, if the injury surveillance study is undertaken for three months, then the injury rates could be multiplied by four to provide the annual injury rates.

1. **Definition of cohorts**

For any injury study, it is important that the study authors clearly define the ‘squad’ or cohort to be studied. The definition of a squad member in the professional world of road cycling will be a rider registered to the team/squad being studied. For tournament injury surveillance studies, e.g. the Olympics, the cohort will be the squad member for that team or country and this can also involve ‘reserve’ riders, who may not eventually go to the actual tournament but will be in attendance at pre-tournament camps, for example. If the time period studied involves the pre-tournament camps, then the ‘reserve’ riders should be included in the tournament squad, with this clearly explained in the study methodology. Of note, it is likely tournament studies will underestimate cycling injuries because, generally speaking, fit/healthy riders will be selected for the tournaments. Thus injury prevalence figures for tournament studies are likely to be less than seasonal/annual studies and this should be considered when reviewing the results of these papers.

For the cohort being studied, it is also important to consider the riders’ contractual status with the road cycling team and we would encourage documenting the riders as professional, semi-professional and amateurs. The status of the rider is documented on their UCI license for the season under study. Professional road cyclists undertake road cycling as their full time occupation, whilst semi-professionals will supplement their income from road cycling through another occupation. Meanwhile amateurs have an occupation away from road cycling but can still earn an income from the sport through, for example, prize money.

1. **Types of injury**

**a)** Match time-loss injury – is defined as either an injury that causes a rider to be unavailable for a race or an injury that causes a rider to stop competing in a race.

**b)** General time-loss injury – is an injury that results in a rider being considered unavailable to undertake training or competition.

**c)** Cycling time-loss injury - is an injury that results in a rider being considered unavailable for cycling training and/or competition. They will, however, be able to do other training activities, e.g. gym-based activities, but not bike-based activities.

**d)** Medical-attention activities – is any injury which required review by any member of the medical department, e.g. doctor or physiotherapist. This class of injuries will therefore include injuries where the rider lost time to training and/or competition as well as those injuries where the person was still able to train and/or compete with the injury or illness.

**e)** An investigation-abnormality injury - is any injury which causes abnormal findings on specific medical tests, including imaging and blood tests. This definition is not recommended for general injury surveillance but instead may be used in studies that are examining a specific body part or specific type of cycling injury. Any use of this injury definition must recognise that there is a high prevalence of abnormal test results in clinically normal athletes.

1. **Coding of injuries**

Specific injuries and illness should be classified as per the revised Orchid Sports Injury Classification System (OSICS), described in the recent consensus paper (5). We would encourage road cycling medical teams to have access to video footage of their riders to allow, ideally, real time video analysis of injuries, facilitating improved injury diagnosis and therefore improving injury management.

1. **Mode of onset**

We suggest differentiating between the following modes of onset:

1. Sudden onset non-contact injury, e.g. acute muscle injury during cycling.
2. Impact/traumatic injury, e.g. due to an impact with another rider or road furniture.
3. Gradual onset injury is when the rider can remember an injury or illness starting and it has slowly worsened over days to weeks to the point that they are now reporting it to medical staff.
4. Insidious onset when the rider cannot remember when the injury or illness started but it has slowly worsened over days to weeks and now requires medical attention.
5. Chronic injury is an acute injury which has now been present for weeks to months and is not resolving with medical management. Medical management may still allow the rider to compete with this type of injury.
6. Medical illness, e.g. an upper respiratory tract infection (URTI), gastroenteritis or overtraining syndrome.

Injury and illness were clearly defined in the STROBE-SIIS paper (5).

1. **Definitions of injury recovery and recurrence**

In general, an injury recurrence is when the same injury (an injury on the same side and body part and the same injury type), occurs in the same surveillance season/year and it has been classified as recovered. An injury is considered recovered once a player has returned to full, unrestricted cycling competitions of any type or grade.

1. **Recovery from road cycling injuries**

**a)** Match-time loss injury –For match-time loss injuries, recovery occurs when the rider is able to return to actual racing competitions.

**b)** General time-loss injury – recovery from a general time-loss injury differs from recovery for a match-time loss injury, in that they have recovered once the medical staff have considered that the rider is available to undertake any training activities, both cycling and off-bike training activities.

**c)** Cycling time-loss injury – recovery from a cycling time-loss injury is when the medical staff have considered that the rider is fit enough to return to cycling-based training. The rider may have been doing gym-based activities before considered recovered from the cycling time-loss injury.

**d)** Medical presentation injuries/illness – recovery from a medical illness/injury is determined by the illness not requiring any further ‘active’ medical management, or if the injury required ongoing medical management for the entire surveillance period, at the end of the surveillance period. Recurrence of medical illness occurs when an illness that no longer required medical management, then required medical attention in the same year.

Ongoing treatments with the aim of maintaining a riders function, e.g. strapping or manual therapy, are not considered ‘active’ medical treatments. Furthermore, the occurrence of some injuries may be related to previous injuries, even when they are not considered as recurrences or have fully resolved.

1. **Time loss to injury**

Mean time loss to injury should be reported in days and divided up into days to return to gym-based training only, days to return to modified cycling training, e.g. on indoor turbo trainer only with no outdoor cycling, days to return to full training and days to return to competition. In terms of days to return to competition, this should be calculated from the day after injury to the day when they are considered fully fit and available for competition selection. That is, the day they are available for competition may be different to the day of their first competition, depending on their race calendar and race availability.

1. **Injury severity based on time absence from competition**

As per previous studies (16), injury severity can be classified by the number of days missing from competition availability. For this variable, we calculate the first day from the day following the injury until the rider is considered to be fit enough to be available for selection for competition. That is, they might not actually ride in a competition for a further period of time due to the lack of competition availability, but if a competition were available, they would be considered medically fit to start for the team. Using this time classification system, mild injuries are between 1-7 days, moderate 8 – 21 days and severe injuries more than 21 days for which the rider is not available for competition.

1. **Calculating road cycling injury rates**

To allow calculation of incidence of road cycling injuries we suggest reporting injuries per 1,000 hours of cycling and then splitting this into per 1,000 hours of training and 1,000 hours of competition. Additionally for the reporting of injuries per 1,000 hours of training, we would suggest dividing this up into per 1,000 hours of training on bike and per 1,000 hours of off bike training.

1. **Injury incidence calculation**

Injury incidence analyses the number of new injuries plus recurrences occurring over a given time period, typically a season or year.

**a)** Match injury incidence – considers only those injuries occurring during cycling competitions/races. This should be calculated per 1,000 hours of competition/racing. The numerator should therefore be the number of new injuries and recurrences occurring during cycling competitions/races, whilst the denominator is per 1,000 hours of racing/competition.

**b)** Training injury incidence – training incidence can be separately measured from match injury incidence. Training injury incidence is therefore the number of new and recurring injuries per 1,000 hours of training. This can be divided into on-bike training incidence and off-bike training incidence by calculating the number of new and recurrent injuries per 1,000 hours of on-bike training and new and recurrent injuries per 1,000 hours of off-bike training, respectively.

We recognise that other denominators can be used but feel that per 1,000 hours of training or competition is the easiest to monitor and report in road cycling, particularly when using the on-bike cycling computers which riders commonly use. Calculating the number of injuries per 1,000 hours of training or competition will also facilitate comparison of injury incidence between road cycling and other sports (17) (16) (14) (5).

**c)** Yearly injury incidence – yearly incidence is defined as the number of defined injuries occurring per squad in a year. This allows match injuries, training injuries (both on- and off-bike) and also gradual and insidious onset injuries to be calculated in the one measurement. A typical World Tour cycling squad will have between 25-30 riders and each rider will do around 80 race days per year. Moreover, for the one-day stage races and the multi-day competitions, there are currently 7 riders in the squad for the competition whilst 8 riders are allowed for the Grand Tours (18).

1. **Injury prevalence measures**

Injury prevalence considers the average number of squad members not available for selection through injury or illness for a given time period, divided by the total number of squad numbers. Injury prevalence should be expressed as a percentage, representing the percentage of players missing through injury on average for that team for the season or year in question and should be calculated on a weekly rolling basis.

Another marker for injury prevalence can be referred to as ‘training injury prevalence’. It is calculated using the numerator of ‘missed training days’, with a denominator of total number of training days for the team for the season, total number of race days and total number of ‘missed training days’. Therefore, an injury prevalence of 12% indicates that for the total number of training and race days in the period under review, 12% of the riders were unavailable to train or race for that study period. Injury prevalence could also be presented as the % number of riders not available for race selection at any one time in the squad and could be calculated on an ongoing basis.

1. **Rider competition availability**

Rider competition availability is calculated as the total of rider competition opportunities (i.e. the total number of competitions multiplied by the full size of the squad) minus the sum of the rider absences due to injury or illness and can be expressed as the average percentage over the period of interest, e.g. one season. Training availability can be calculated in the same way. These terms can be a useful metric to communicate risk to stakeholders, such as racing sponsors, team owners and the general public, amongst others.

1. **Prospective versus retrospective epidemiology studies**

To allow greater interrogation of the study results as well as to improve the accuracy of the results from the study, we would advise conducting prospective rather than retrospective epidemiology studies although we appreciate that this is not always possible.

1. **Study consent**

We would encourage researchers to consider ‘opt out’ consent options rather than ‘opt in’ consent for these epidemiology studies to allow greater coverage of the target population.

1. **Sudden cardiac arrest (SCA) or death (SCD) and sudden death**

In keeping with other authors (15), we define SCA and SCD as a cardiac arrest or death of the rider from an underlying sudden cardiac arrhythmia during or within one to twenty-four hours of participation in a road cycling event. Endurance road cyclists are at relatively high risk of cardiac arrhythmias and death (19) (20) and it is therefore important to specifically recognise this as the cause of death. This data will allow us to understand the incidence/prevalence of this condition and put in place improved cardiac management for our riders. Additionally, a sudden death is one in which the rider dies immediately from the injuries sustained or within 24 hours of the injuries sustained, as per previous authors (15).

1. **Individual rider data**

We feel that the minimum individual rider data that should be reported in injury surveillance studies is age and sex of the rider as well as their overall position in the team (GC rider, sprinter, climber or rouleur). Ideally the circumstances around a crash should be described, e.g. weather conditions and whether it was a time-trial event or stage road race. All rider data should be reported by a study code, which is only identifiable by the lead researcher in each study, to ensure patient confidentiality, in keeping with best medical research practice (21).

1. **Injury and illness reporting form**

To facilitate improved injury and illness surveillance reporting in road cycling, we have provided an example of a data collection form (**RC-Med form**) to be used in road cycling surveillance studies. This will ideally be redesigned as an electronic application for ease of data gathering (**Appendix 1**).

1. **Who should conduct these studies?**

The whole medical department of the road cycling team should be briefed and engaged in the collection of data for these injury studies. However we would encourage one person, ideally the head of medicine for each team, to be the lead in collating the data for their team and sharing this with the researchers, to ensure consistency and completeness of data. We would also advise collecting the data on a weekly basis so that any ‘missing’ data can be clarified with the relevant medical department, ensuring accuracy of reporting.

1. **High quality surveillance studies require funding**

As previously highlighted by authors within injury surveillance (22), high quality injury and illness surveillance studies require adequate funding. We therefore call on the international federation, Union Cycliste Internationale, UCI, and professional road cycling teams to provide ongoing funding to allow prospective injury and illness epidemiology studies across road cycling teams, both in the professional game and the amateur ranks.

**Discussion**

This consensus paper has evolved from the previous consensus injury/illness surveillance studies published in other sports as well as utilising the road cycling medical expertise of the authors. We hope that this paper will allow injury surveillance studies in road cycling to be undertaken using consistent methodology and therefore, improve repeatability of the studies. These studies will help medical professionals involved in road cycling to better understand the injury and illness risks to their riders over the course of a tournament or season/year and then develop appropriate injury/illness prevention programmes to improve the safety of road cycling. We encourage collaboration with equipment manufacturers in implementing these injury prevention programmes, for example improved cycle helmet design. This consensus paper should be used with the STROBE guidelines (5) when reporting any injury surveillance epidemiology study in road cycling.

As well as the consensus paper leading to more consistency in road cycling injury/illness surveillance studies, it is hoped that the methods used in this consensus paper will allow us to more accurately compare our illness/injury rates to other sports. These will hopefully then lead to a greater cross-pollination of medical knowledge between sports, helping to improve the medical care within road cycling.

Concussion is a hot topic in sport medicine and we previously published a proposed concussion assessment protocol for use in road cycling (23). We are therefore keen to learn from other authors in this area and get a better understanding of the incidence and prevalence of concussion in road cycling as well as the long-term consequences of concussion and the length of time to return to competition from a concussion in road cycling.

We appreciate that this is a first attempt at a consensus paper for injury/illness surveillance studies in road cycling and that further definitions will be added to this paper. We would therefore appreciate feedback from both the community of road cycling health professionals as well as wider health professionals involved in sport medicine to further expand the definitions included in this first expert paper. We also appreciate that there are other variables that researchers may wish to collect about the injury, e.g. recent long-haul flights and the risk of illness. This expert paper has the objective of establishing the minimum set of data variables for injury and illness surveillance studies and we hope that this paper can be built-upon and strengthened by further versions.

We would encourage the UCI, as the international federation of cycling, to adopt this expert paper and support researchers in conducting prospective injury and illness surveillance studies, including providing research funds to undertake appropriate epidemiology injury/illness studies in road cycling.

**Conclusion**

This UCI endorsed expert paper for reporting injury and illness in professional road cycling epidemiology studies will help standardise data collection, methods and reporting for medical encounters in road cycling teams. This paper will therefore foster high-quality data collection in these road cycling epidemiology studies and allow dependable comparison between different road cycling teams and with other sports. We hope that the consistent reporting of road cycling injuries in epidemiology studies will: 1) guide the direction of future efforts to reduce and prevent injuries and illness in road cycling, particularly around mandatory safety equipment for road cyclists, and; 2) allow better medical support for road cyclists as well as safer organisation of road cycling events. As the number of reproducible injury epidemiology studies in professional road cycling increases, we hope that this can be replicated in female road cycling, amateur events as well as para-cycling and as this occurs, updating of this expert statement. This paper should ultimately protect the riders’ health and we hope that fellow researchers in road cycling will adopt and support the guiding principles of this statement.

**Endorsements**

This paper has been endorsed by the world governing body of cycling, the UCI.

**Competing interests**

Nil  **Acknowledgements**

Nil.

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 **Ethical approval information**

Not applicable.

 **Data sharing statement**

All data has been included in the review and is free to be shared and published.

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