

Incidence of injuries and illness and related risk factors in mountain biking events: A systematic review protocol

Kim Buchholtz (✉ kim.buchholtz@uct.ac.za)

University of Cape Town Division of Exercise Science and Sports Medicine <https://orcid.org/0000-0002-1976-345X>

Mike Lambert

University of Cape Town Division of Exercise Science and Sports Medicine

Theresa Burgess

University of Cape Town Faculty of Health Sciences

Protocol

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Abstract

Background Cycling is a popular sport and method of transportation globally but is a significant contributor to sports injury admissions in hospital emergency units. Mountain biking events present additional challenges with remote venues, and isolated courses. Most mountain biking events will provide on-site medical care for both injury and illness occurring during races. These data are essential to understand the true incidence of injury and illness in mountain biking events as national health data may not represent these unique events specifically. **Methods** This review will follow the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement. Search engines PubMed, Scopus, SPORTDiscus (EBSCOhost), PEDro and the Cochrane Library will be systematically searched. Gray literature searches of Google Scholar and manual searching of reference lists and congress abstracts from cycling specific congresses will be conducted. Journal articles documenting illness and injury in adults participating in mountain bike cross-country marathon events will be included. A narrative analysis of the types, severity and area of injuries; and illness type and severity will be performed. A quantitative analysis may be performed should there be sufficient studies reported in the same format. **Discussion** This protocol outlines a systematic review on injury and illness in mountain biking events. Data from hospital records may not adequately represent the burden of injury and illness at events held in remote venues, especially if those treated on site do not require further hospital based treatment. This review will assist with the development of further research in this area, and in preparation of clinicians working in these types of events. **Systematic review registration:** This protocol has been registered with PROSPERO International prospective register of systematic reviews (No: CRD42019134586).

Background

Cycling is an increasingly popular sport and is used as both a recreational activity and a form of transport globally (1). Cycling is made up of two main categories, 'road' (or street) and 'mountain' (or off-road) biking. Mountain bike racing is further described by the Union Cycliste Internationale (UCI) as cross-country, cross-country marathon, downhill and four-cross (2). Cross-country is exclusively an elite competition for professional riders, while cross-country marathon includes both amateur and professional riders in the same races on the same routes. These routes are usually between 60 and 120km (2). Mountain biking includes highly technical riding through rough terrain, forest tracks, gravel pathways and steep downhills, with only a small percentage of riding on tarred roads (2). The challenges of road cycling include negotiating other vehicles and pedestrians in traffic (3,4). Mountain bikes, while varying widely in design, in general, have wider tyres with greater grip and suspension on either the front wheel, or both, in comparison to road bicycles (5). Competitive races are becoming more demanding and have evolved into multi-stage races in both road and mountain cycling categories (6).

As participation in cycling has increased, conflicting evidence on the incidence of injury has emerged (5,7). Both Denmark and the United States report a national decrease in cycling injury incidence, while Australia has reported an increase in cycling injuries presenting to emergency departments (5,8,9). In the United States, cycling injuries account for 12.7% of all sports- or exercise-related injuries, and of these injuries, only 9.5%

occurred during 'sporting activity' (7). The majority (56%) occurred while commuting on the streets, with 70% of street injuries involving a motor vehicle (7).

Fifty percent of mountain bikers have reported at least one serious acute injury related to mountain biking and in professional mountain bikers this number increases to 80% (5). The incidence of injury among cross-country marathon riders is 7.5 and 3.1 injuries per 1000 hours in males and females respectively (10). Downhill riding is associated with a significantly greater incidence of injury (males; 46.8 injuries per 1000 hours, and females; 42.7 injuries per 1000 hours) (5). The unique challenges in mountain biking include rough terrain and prolonged periods of cycling in isolated environments, with unpredictable weather conditions (5). Physical fatigue related to the repeated isometric contractions due to vibrations from the terrain has been linked to a reduction in hand grip strength and may increase the risk of falling in mountain biking specifically (10,11). Most data on cycling injuries report cases presenting to emergency departments; these data may underestimate the incidence, particularly of the less serious injuries. Many race events have onsite medical care, due to the remote locations, and these riders may never be admitted to hospital (12). Care must be taken in extrapolating national cycling injury data to cycling race events as the mechanisms, incidence and management of these injuries may differ between commuting and events.

Acute injuries in mountain bike racing may result from falls and collisions, or rapid and forceful contractions resulting in musculotendinous injuries, contusions or bony fractures (13). Chow et al (2002) reported that falls related to collisions with other riders accounted for 17% and mechanical failures accounted for a further 16%. The remaining 68% were caused by loss of control (32%), loss of traction (14%), collisions with stationary objects (7%) and other or unknown causes (14%) (13). There are more spinal injuries in mountain biking than in road cycling due to the rider falling over the handlebars onto the top of the head (14). Injuries in mountain biking events present a unique challenge to event organisers. Riders may present with a combination of muscle strains, joint injury, overuse injury and trauma related to falling, and there may be a lack of access to injured athletes related to the environment/terrain (15).

Illness in mountain biking is not well reported. Most of the data are from a limited number of race events (16,17). Gastrointestinal illness, allergies, respiratory illness, dehydration, headaches and skin irritations are the most commonly reported illnesses in cycling events (16,18,19). In the 2016 Olympic Games, approximately 5% of mountain bikers were treated for a variety of illnesses by their medical teams (16).

The reporting of injury and illness in events varies depending on the definitions used by the researchers. The International Olympic Committee uses a medical attention definition for both injury and illness, and includes all occurrences of injury or illness reported to the medical teams regardless of the effect on the athlete's ability to continue training or to compete (16). Severity of the injury or illness is determined by the number of days absence from training or competition, and more than one week is defined as 'severe' (16).

The Consensus Statement of Epidemiological Studies in Athletics defines injury 'a physical complaint or observable damage to the body produced by a transfer of energy of the athlete' (17). Illness is defined as a 'physical or psychological complaint or manifestation by an athlete not related to injury' (17). This consensus statement is explicit that injuries and illness have occurred regardless of the impact on training or competition and whether or not medical attention was sought. This definition has been adapted for use in a

previous cycling study, but injuries and illness were reported based only on medical attention following interactions with medical staff in spite of the definition (18). When only including medical attention injuries, it is possible to underestimate the incidence as riders who are able to continue without medical intervention, or are self-treating would not be considered injured.

Significance of this systematic review

Injury and illness prevention programmes require knowledge of the aetiology and magnitude of the injury or illness problem within the context of the sport (20,21). The current available knowledge in cycling is largely based on commuter cycling and hospital admissions. This systematic review will provide a comprehensive review of the available injury and illness statistics and reporting in mountain biking events of different lengths. Differences in injury reporting methods will be identified and may assist in the development of a more appropriate injury definition specific to mountain biking. The magnitude of the injury and illness problem in mountain biking races will be identified. Existing gaps in the literature will be also be identified for further investigation.

Methods

Aim

To identify the incidence of injury and illness in mountain biking single day and stage races

Specific Objectives

The specific objectives of this systematic review are:

1. To assess the epidemiology of injury in single day and multi-stage mountain bike events
2. To assess the epidemiology of illness in single day and multi-stage mountain bike events
3. To assess factors relating to injury in single day and multi-stage mountain bike events
4. To identify the definitions and reporting methods in mountain biking-related injuries
5. To identify mechanisms of falling and injury in single day and multi-stage mountain bike events

The methods for this systematic review will follow the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols 2015 Statement (PRISMA-P) (Additional file 1)(22).

Eligibility criteria

Observational, cohort, epidemiological studies assessing the incidence and prevalence of injury and illness in single day and multi-stage mountain marathon cycling races as described the UCI category, cross-country marathon, will be included in the study (2). Studies will be included should they be either prospective or retrospective studies of races of longer than 60km over one or more days (as per the UCI cross-country marathon category) (23). Races will not be excluded if they are not UCI accredited races as long as they meet the distance requirement. Events of both a professional and recreational or amateur nature will be included. No date limitation will be applied to the search strategies. Articles written in English will be included. Non-

English articles will only be included if they are readily available with evidence of being professionally translated (including both forward and backward translation for accuracy) into English following publication.

Studies including mountain bikers, over 18 years of age will be included. Data on both professional and recreational cyclists will be included in the review and will be presented separately if available.

Outcome measures

The primary outcome measures to be assessed will be the incidence of injury and illness during the event. Secondary outcome measures will include the severity and location of the reported injuries, the type of injury, the rider's ability to continue in the event, prevalence of injury preceding the event, pre-event training distances and the experience/expertise of the riders (novice, semi-professional, professional). Illness diagnosis, severity and the rider's ability to continue in the event will be additional secondary outcome measures. The definition of injury, illness and severity (of both) used in the study will be noted on the extraction form due to possible differences between studies.

Information sources

The following databases will be searched: PubMed, SPORTDiscus (EbscoHost), Scopus, PEDRO and the Cochrane library. Congress abstracts from cycling specific congresses will be reviewed to identify unpublished studies. A gray literature search in Google Scholar will be performed following the database searches. A manual search of the reference lists of eligible articles identified during the search will be performed.

Search strategy

Databases will be searched with the following keywords: (Mountain OR off-road OR cross-country OR races OR racing OR stage race) AND ((Bicycling [MeSH]) OR cycling OR biking OR bikers OR cyclists OR bicycl*) AND (Injuries OR injury OR falling OR Illness OR epidemiology) AND (soft tissue OR fractures OR concussion OR skin abrasions OR gastrointestinal OR respiratory OR dehydration)). A brief scoping review has previously been performed to evaluate the availability of research in both injury and illness.

Following the keywords search, two independent researchers will screen the title and abstracts for eligibility based on the above-mentioned criteria. All abstracts and titles following this search will be downloaded to Covidence (a Cochrane technology platform). The two reviewers will be given independent access to the platform and will be able to rate each abstract and title for inclusion or exclusion. Should the reviewers disagree on the inclusion or exclusion of an article, they will discuss and consent or a third person will be approached to decide on the article's eligibility.

Following title and abstract screening, two independent reviewers will review the full text articles for final eligibility and inclusion into the review. The reviewers will discuss and consent on inclusion or a third person will decide on inclusion of specific studies if there is disagreement between the two reviewers. Once the articles have been included, two independent reviewers will extract the appropriate data from the text.

Data extraction and management

Data will be extracted by two independent reviewers, using a pre-designed data extraction form (Additional file 2), including data on participants (age and sex), cycling event (length of stages, total race length, environmental conditions and type of cycling), injury (area of injury, diagnostic practitioner and time off event), illness (type of illness, diagnostic practitioner, severity, time off event and whether the rider had a full recovery), study design, and risk of bias. All data will be managed in Covidence (a Cochrane technology platform) online.

Risk of Bias and Quality Assessment

The AXIS tool for critical appraisal of cross-sectional studies will be used to assess the reporting quality and risk of bias (Additional file 3)(24). The tool provides 20 questions, with seven each addressing quality of reporting and quality of design, and six on potential areas of bias. Each question may be answered as 'yes', 'no' or 'don't know/unclear'. Comments by reviewers are encouraged to incorporate flexibility in the assessment of the quality and bias.

Bias assessment

Risk of bias will be assessed based on the selection of participants, respondents and non-respondents (and the reason for non-responses) and the internal consistency of the studies. Risk of bias will be reported as 'unclear' if the required information is not provided by the authors.

Quality of reporting

Reporting quality assessment includes questions on whether the aims, population and methods are clearly reported in the article. Results and limitations need to be adequately described and discussed. Studies will be recorded as 'unclear reporting quality' if the content of these questions are not reported in the study.

Quality of design

The quality of design will be evaluated on its appropriateness for the aims of the study and the justification of the sample size and frame. Conflicts of interests and ethical approval will be assessed in this section.

Data synthesis

All injury and illness data will be reported as an incidence (per time period) or as prevalence (percentage). Descriptive summary tables will be populated with information from each study, including study design, participants, context (events, distance, environment) and outcomes (illness or injury, ability to continue riding). A narrative analysis of the types, severity and area of injuries; and illness type and severity will be performed and presented in tables. Based on the previous scoping review, the available data is most likely to be suitable for a 'systematic search and review' type analysis (25). A quantitative analysis may be performed should there be three or more studies with sufficient data reported in the same format or with the same definitions of injury and illness, as either incidence or prevalence. Only high-quality studies will be included for meta-analysis. Studies with a high risk of bias, or poor study or reporting quality will be excluded from meta-analysis. Following risk of bias assessment, two independent reviewers will decide on the inclusion of the studies in a meta-analysis based on the above criteria. Pooled data will be assessed using

OpenMetaAnalyst using the means of the injury and illness incidence. Should insufficient data be available, crude pooled incidence calculations per 1000 hours will be performed as will prevalence with 95% confidence intervals. Sub-group analyses of age, sex, type of cycling and experience may be conducted depending on the studies included in the final review.

Declarations

Declarations:

Ethics approval and consent to participate:

This study has been approved by the University of Cape Town's Faculty of Health Science's Human Research Ethics Committee (HREC No: 302/2019)

Consent for publication: Not applicable

Availability of data and materials: Not applicable

Competing interests: The authors declare that they have no competing interests

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Author's contributions:

KB conceived of the study and developed the protocol. ML and TB conceived of the study and provided supervision of the protocol development. All authors read and approved the final manuscript.

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Additional Material

File name: Additional file 1

File format: .pdf

Title of data: PRISMA-P Checklist

Description: PRISMA-P as requested for protocol

File name: Additional file 2

File format: .pdf

Title of data: Data extraction form

Description: Data extraction form for use by reviewers

File name: Additional file 3

File format: .pdf

Title of data: AXIS critical appraisal tool

Description: Critical appraisal tool for use by reviewers in assessing study quality and bias

Supplementary Files

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