

Mountain Bike Injury Incidence and Risk Factors Among Members of a Wisconsin Mountain Bike Club

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ABSTRACT

Background: This study aimed to assess the incidence of and risk factors for mountain bike injuries among users of a local mountain bike trail system.

Methods: An email survey was sent to 1,800 member households, and 410 (23%) responded. Exact Poisson test was used to calculate rate ratios, and a generalized linear model was used for multivariate analysis.

Results: The injury incidence rate was 3.6 injuries per 1,000 person-hours of riding, with beginners at a significantly higher risk compared to advanced riders (rate ratio = 2.6, 95% CI, 1.4-4.4). However, only 0.4% of beginners required medical attention, compared to 3% of advanced riders.

Conclusions: More injuries occur among beginning riders, but the injuries are more severe with experienced riders, suggesting higher risk-taking or less attention to safety measures.

BACKGROUND

Mountain biking, or off-road biking, as a recreational sport rapidly gained popularity during the COVID-19 pandemic.¹ As an outdoor activity, mountain biking can improve physical fitness and has many mental health benefits.² However, it also can cause injuries, such as bone fractures or traumatic brain injuries.³ Despite more people mountain biking, few studies focus on mountain bike injury prevention, surveillance, and management. Most existing mountain bike injury studies focus on professional races⁴ or commercial mountain bike parks.⁵ Lack of community-based mountain bike injury epidemiologic studies makes it chal-

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lenging for physicians to advise patients on mountain biking safety.

Information from existing mountain bike injury studies is of limited utility for community injury prevention guidance, because different studies use different methods and focus on different study populations. For example, some studies use emergency department data to report mountain bike injuries,⁶ while others use case report systems to monitor injury rates.⁷ One study focuses on professional mountain bike racers,⁴ while another focuses on mountain bike magazine subscribers.⁸ Few studies focus on risk factors related to amateur mountain bikers that community phy-

sicians may encounter.

Moreover, injury rates are measured inconsistently in existing studies and, thus, difficult to compare. Riding time is a known exposure to injury – the longer people ride, the more they are exposed to injury risk. However, it is hard to record the precise time a person spends on a mountain bike. Some studies omit the riding time and report injury rate as a proportion.⁹ Others estimate lifelong riding time, which is prone to severe information bias.^{6,10}

Our study focuses on acute mountain bike injuries of community mountain bikers at different skill levels and takes riding time into consideration when calculating injury rate. We hope to provide a more accurate mountain bike injury rate and identify risk factors to help design injury prevention interventions and assist physicians to better advise patients on mountain biking safety.

METHODS

This was a cross-sectional study. An online Qualtrics survey that took approximately 10 minutes to complete was sent to mem bers

Table. Descriptive Analysis of Risk Factors for Mountain Bike Injury Rate

Factor	Total Participants	Rate of Injury (per 1,000 Person-Hours of Riding)	Rate Ratio (95% CI) (Unadjusted, Exact Poisson Test)
Age group			
2–12	85 (9.7%)	4.3	1.5 (0.79–2.9, $P=0.22$)
13–20	104 (11.9%)	6.3	2.2 (1.04–4.5, $P=0.04$)
21–40	185 (21.1%)	3.7	1.3 (0.66 to 2.5, $P=0.48$)
41–60	379 (43.2%)	2.8	Ref.
60+	121 (13.8%)	3.5	1.2 (0.38–3.2, $P=0.79$)
Years of experience			
0–2	290 (33.1%)	6.4	2.4 (1.4–4.4, $P=0.002$)
3–10	334 (38.1%)	2.6	Ref.
10+	253 (28.8%)	3.2	1.2 (0.67–2.2, $P=0.57$)
Gender			
Female	289 (33.0%)	2.5	Ref.
Male	571 (65.1%)	4.1	1.7 (0.93–3.2, $P=0.10$)
Nonbinary/prefer not to say	17 (1.9%)	2.9	1.2 (0.03–7.7, $P=1.00$)
History of mountain biking lessons			
Yes	331 (35.5%)	3.2	Ref.
No	565 (64.4%)	3.9	1.2 (0.73–2.0, $P=0.54$)
Self-reported level			
Advanced	199 (22.7%)	2.6	Ref.
Intermediate	396 (45.2%)	3.2	1.2 (0.70–2.3, $P=0.53$)
Beginner	281 (32.0%)	7.7	3.0 (1.6–5.9, $P=0.001$)

of a local mountain bike club located in Middleton, Wisconsin. The club is a nonprofit 501c3 organization, and riding is limited to members only. It has about 10 miles of mountain bike trails that are maintained by volunteers. There were 1,800 registered households during the survey period from October 7 to November 13, 2021. The survey was distributed through member registered emails, club newsletters, and a members-only Facebook page. Club members who biked between June 1 and September 30, 2021, on the club property were included.

All participants were asked general information, including age, gender (male, female, nonbinary/prefer not to say), years of mountain biking experience (0–2, 3–10, >10 years), history of taking mountain bike lessons (yes/no), and their self-estimated level of expertise (beginner, intermediate, advanced.) Riding time was calculated from self-reported average times per week and average hours/minutes per ride during the previous 4 months. Injury was defined as acute unexpected injury that caused pain or limitation of activity. Participants were asked to report number of injuries while riding a mountain bike on the club trails during the time of interest (June 1 - Sept 30, 2021), a detailed description of each injury, and if those injuries required medical attention (ie, seen by a health care provider).

Data analyses were completed using R studio (Rstudio Team, IDE 2022.02.4). Crude rate ratios of each risk factor and their 95% confidence intervals were calculated using an exact Poisson test. Intermediate riders and advanced riders were then combined into an experienced group; rate ratios compared to begin-

ner riders were calculated and adjusted for age, gender, years of experience, and history of mountain bike lessons using a Poisson generalized linear model.

The study protocol was exempted from the University of Wisconsin Health Sciences Institutional Review Board since it was part of a quality improvement effort at the club. All participants were provided with survey information before they began the survey.

RESULTS

An estimated 1,800 households received the survey link. Of these, 410 households completed the survey (23% response rate), providing information for 877 individual bikers. The average age of the study population was 32.4 years (range, 2–73.) There were 571 (65%) riders who identified as male, 289 (33%) female, and 17 (2%) who identified as nonbinary or preferred not to say. The average years of mountain bike experience was 9.7 (range 0–58 years). The respondents reported having beginning (32%), intermediate (45%), and advanced (23%) skills, and 331 (36%) riders reported having taken a mountain bike lesson.

Among all respondents, 62 (7.0%) reported an injury and, of those, 19 (2.2%) reported an injury that required medical attention. The overall incidence rate was 3.6 injuries per 1,000 person-hours of riding. Higher rates were observed among male, younger (age 13–20), less experienced (<3 years riding), and beginning riders (Table). After multivariate analysis, beginners remained at significantly higher risk compared to more advanced riders (RR = 2.6, 95% CI, 1.4–4.4). However, beginners described their injuries as “abrasion, bruises, and scrapes” that did not require medical attention. In contrast, 12 advanced riders reported joint and bone injuries, and 13 reported the injuries were due to being “too fast, aggressive, or attempting a jump.” Overall, only 0.4% of beginners required medical attention, compared to 3% of more advanced riders.

DISCUSSION

In this cross-sectional survey of recreational mountain bikers at a community biking club, mountain bike injuries were uncommon overall, with only 1 injury per 300 hours of riding, on average. The cross-sectional design and well-defined population and trail area allow future studies at the same club to provide time trend of injury rate and a platform to evaluate the effectiveness of injury prevention methods.

Overall, beginners reported a higher risk of injury. This find-

ing is different than the 2001 Gualrapp et al study,⁸ which used similar methods (distributing a survey to mountain bike magazine subscribers) and found that there was no significant difference in the injury rate between beginners and athletes with more than 4 years of experience. Gualrapp et al⁸ did not provide details on how riding time was collected. Based on the survey design, this time might be lifelong riding time for both beginners and advanced riders. All advanced riders started as beginners, and their injury rate changed as their skill level advanced. Thus, we think our cross-sectional design (focusing on one summer of riding) to investigate skill level as a risk factor yields more accurate results.

Despite a higher injury rate, most injuries reported by beginners were minor and did not require medical attention. In contrast, advanced riders had more joint and bone injuries than beginners, which also was reported in Gualrapp et al.⁸ The most common causes of severe injuries were high speed, poor judgment of the trail condition, and attempting jumps. This suggests that the balance between experience and confidence plays a role in the cause of injury. Beginners have less experience and less confidence. They are more likely to hesitate and stop, causing more low-speed injury and/or injury on safer trails, which tend to be minor. Advanced riders have more experience and, for some, more confidence. Over-confidence can make a rider take greater risks or pay less attention to safety measures, causing more severe injuries. When it comes to injury prevention, more riding time to gain familiarity with the bike and the trail might help a beginner to reduce injuries. On the other hand, improved trail design and caution signage for advanced riders might prevent severe injuries.

Strengths of this study include the study population of community mountain bike riders, the short interval between study period and survey distribution time to improve recall, and the use of person-hours of riding. Limitations include the cross-sectional study design, which is prone to selection bias, the time lag from injury to the survey, and the low response rate. Ideally, research could be done using ongoing, active surveillance of injuries or video recording of the incident and on-the-spot rider interviews, as is done during professional mountain bike races. However, this would be costly and may be impractical in a community setting. Other limitations of our study include the lack of information on distance ridden, vertical distance ridden, and terrain ridden. The geographic information and more accurate time exposure can be recorded by global positioning system (GPS) devices. With more and more riders recording their activities on sports applications like Strava, those data can be available for future studies.

CONCLUSIONS

Mountain biking is an enjoyable sport and has significant health benefits for children and adults. However, injuries do occur and sometimes can be serious, requiring medical attention. Our study

shows that the risk of injuries is low overall, and that beginner riders are at higher risk of minor injuries, while advanced riders are at high risk of serious injuries. This information should be used to design injury prevention efforts, such as more riding time for beginning riders and improved trail design and signage for more advanced riders

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