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Epidemiology of Cycling Injuries at a Provincial Championship: A Cross-Sectional Study

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Abstract

Background: Cycling is a sport in which participants use bicycles to complete a predetermined route in the shortest possible time. The categories contested include mountain biking and road racing.

Objective: This study aims to determine the prevalence, types, and locations of injuries among cycling athletes participating in the 2024 South Kalimantan Provincial Cycling Championship (KEJURPROV).

Methods: This study employed a cross-sectional quantitative observational design with a retrospective approach. It was conducted during the 2024 KEJURPROV and involved 66 athletes selected through total sampling. Data on injury types and locations were collected using validated questionnaires. The findings of this study are expected to provide useful evaluation material for coaches and athletes in designing more effective training programs.

Results: The results showed that the most common type of injury experienced by cycling athletes was strain (80.3%), followed by contusion (53%) and open wounds (51.5%), The lower extremities were the most frequently affected injury location (86.4%), followed by the upper extremities (42.4%). Most athletes were younger than 18 years (56.1%), male (84.8%), and used mountain bikes (62.1%).

Conclusion: Injuries sustained during the 2024 KEJURPROV were predominantly soft-tissue injuries affecting the lower extremities. Younger athletes, males, and mountain bike users showed higher injury prevalence, highlighting the need for targeted injury-prevention strategies.

Keywords
Athletic Injuries; Bicycling; Epidemiology; Athletes; Indonesia; South Kalimantan

Introduction

Sports are one of the physical activities that significantly influence physical, mental, and social health. Physical activity plays an important role in improving quality of life, particularly an individual's physical fitness.[1] In addition to sports as a form of recreation, sports can also serve as a medium for achievement. Competitive sports are physical activities aimed at developing individuals holistically through planned efforts to achieve victory.[2]

Cycling is a competitive sport in which athletes ride bicycles to complete a designated course in the shortest possible time. The discipline consists of several categories, including mountain biking, road cycling, BMX (bicycle motocross), and track cycling.[3] This sport involves complex movement patterns and considerable physical demands, which may predispose athletes to various forms of injury. Due to its high-risk nature, cycling is classified as an extreme sport, where injuries may arise from internal factors such as the athlete's physical condition, as well as external factors including terrain characteristics, equipment, and environmental conditions.[4]

Despite the well-recognized health benefits of cycling, elite professional cyclists remain susceptible to a range of injuries and medical conditions associated with high-intensity training and competition. An epidemiological investigation by Haeberle involving Tour de France participants reported that, out of 1,584 professional cyclists evaluated over an eight-year period, 259 riders (16%) were forced to withdraw from the race, averaging 17 withdrawals per year. Among these, 138 withdrawals were attributed to acute traumatic injuries, nearly half of which (49%) involved fractures, and 29 athletes required surgical intervention for fracture management.[5] Similarly, Willick et al. reported 1,155 injury events among mountain biking athletes participating in the National Interscholastic Cycling Association (NICA) competitions during the 2018 and 2019 seasons.[6]

A systematic review by Buchholtz et al. reported that injury prevalence in cross-country marathon mountain biking varies widely from 4% to 71%, with skin injuries being the most frequently documented, followed by bony and soft-tissue injuries as consistently identified across the included studies.[7] The clavicle was found to be the most commonly fractured bone. Among cyclists who underwent surgical treatment for their fractures, the return-to-competition period was more than one month longer compared to those who did not undergo surgery.[5] Furthermore, in road cycling, the most common injuries include abrasions, hematomas, fractures (particularly clavicle fractures), overuse injuries (most commonly affecting the knee), and head injuries, with upper limbs being more frequently affected than lower limbs. This injury pattern is distinct from many other sports and therefore requires specific strategies to enhance athlete safety.[8]

In South Kalimantan, cycling has become increasingly popular, marked by a growing number of cycling communities and events. The geographical characteristics of South Kalimantan, consisting of mountainous areas, hills, as well as varied urban and rural roads, present unique challenges for cyclists. These factors have the potential to influence the injury patterns experienced by cycling athletes in the region.

The epidemiology of sports injuries and illnesses has recently been emphasized as a strategic priority within the newly launched UCI 2030 Agenda. This initiative seeks to enhance athlete fitness, reduce the incidence of accidents and injuries during competition, and strengthen medical preparedness to support safe and optimal athletic performance.[9] However, to date, there has been no epidemiological report specifically examining cycling-related injuries in Indonesia, particularly at the provincial championship

level in South Kalimantan. The absence of national and regional data has resulted in limited understanding of injury patterns, risk factors, and contextual characteristics experienced by Indonesian cyclists.

Therefore, this study was undertaken to provide insight into the prevalence and characteristics of injuries sustained by competitive cyclists. Local data on injury prevalence, types, and anatomical locations are crucial for coaches, athletes, and program managers, as such information supports the development of effective injury-prevention strategies, the design of safer and more targeted training programs, and the strengthening of education related to the appropriate use of protective equipment. Accordingly, this study aims to describe the prevalence, types, and locations of injuries experienced by competitive cycling athletes participating in the 2024 South Kalimantan Provincial Championship (KEJURPROV). The findings of this study are ultimately expected to contribute to the advancement of safer and more sustainable competitive cycling practices in South Kalimantan.

Methods

This study employed a cross-sectional quantitative observational design with a retrospective approach to systematically examine the injury patterns experienced by cycling athletes. The quantitative framework was selected to enable objective measurement, numerical interpretation, and statistical explanation of injury variables within the athletic population. The retrospective approach allowed the researchers to analyze events that had already occurred within a defined period, namely injuries sustained during the 2024 South Kalimantan Provincial Cycling Championship (KEJURPROV). The cycling championship was held on 26–27 October 2024 in Banjarbaru City, South Kalimantan. This design was selected because it provides an efficient mechanism for investigating the frequency, type, and distribution of injuries without manipulating competition conditions.

The study population comprised all 86 athletes officially registered with the Indonesian Cycling Federation of South Kalimantan and who competed in the 2024 KEJURPROV tournament. A total sampling strategy was employed, in which all athletes meeting the inclusion criteria were invited to participate, as the study aimed to capture the full spectrum of injury characteristics within the entire population of competitors rather than relying on random selection. Determination of minimum sample size was calculated using the Slovin formula, with a 95% confidence level and a 5% margin of error. The calculation yielded a minimum requirement of 71 respondents. Although total sampling was implemented and all eligible athletes were approached, the number of athletes who ultimately provided complete data was 66, which is slightly below the minimum estimate. This shortfall may modestly reduce the generalizability of the findings. However, its impact on descriptive interpretation is likely minimal given that the dataset still represents the vast majority of the competitive population.

However, during data collection, only 66 athletes voluntarily provided informed consent and completed the study questionnaire in full. Participants were included if they: (1) were registered as official competitors in the 2024 KEJURPROV cycling event; (2) had sustained at least one injury during competition within the event period; and (3) agreed to participate by signing the informed consent form. Athletes were excluded if: (1) they did not complete the questionnaire; (2) could not recall information regarding the injury event; (3) sustained non–sport-related injuries. Of the 71 eligible athletes, 66 athletes provided informed consent and were included in the final analysis, while 15 athletes declined to participate and 4 athletes withdrew from the competition. Data collection was conducted through coordination with team managers, without direct recruitment at the competition venue, to ensure ethical and accurate data collection procedures. Additional administrative verification and data clarification were conducted between June and July 2025 to ensure only the completeness of retrospective injury reports, without collecting additional variables such as training history or workload.

The exposure variables were strictly limited to athlete characteristics that were directly measured: age, sex, cycling experience, and type of bicycle. No training-related or performance related variables were collected. These variables were analyzed descriptively to identify patterns in injury occurrence among participants. Injury events were considered naturally occurring outcomes based on athletes' participation and activity levels, without any experimental manipulation, thereby allowing the study to reflect real competitive conditions. In this study, a sports injury was operationally defined as any physical complaint, pain, or tissue damage that occurred during the KEJURPROV event period including both competition and associated training sessions regardless of severity and without requiring time-loss or activity restriction, provided that the injury was directly related to cycling activity.

The outcome measures in this study focused on two principal variables: (1) type of injury, and (2) injury location. Types of injury included open wounds, hematomas/contusions, sprains, strains, fractures, dislocations, and head injuries. Injury locations consisted of the head/neck, upper extremities, back/chest/abdomen, and lower extremities. Athlete characteristics were categorized according to the analytical structure used in the results section, including age, cycling experience, and type of bicycle. Age was grouped into <18 years, 18–21 years, and >21 years, reflecting differences in physical development and motor maturity. Cycling experience was classified as <1 year (beginner), 1–3 years (intermediate), 4–6 years (advanced), and >6 years (experienced), based on typical skill progression over these time spans. Bicycle type was categorized as mountain bike or road bike. These categorizations were applied to ensure meaningful subgroup comparisons and to maintain consistency with the descriptive statistics presented in Table 2.

Additionally, the mean and standard deviation of age were calculated to provide a more detailed descriptive overview. Injury frequency was self-reported, and athletes indicated how many times each injury type occurred during the event period. For quantitative analysis, responses were converted into numerical scores (1 = once, 2 = two to three times, 3 = four to five times, 4 = more than five times). Mean values in Table 1 were computed by summing the assigned scores and dividing by the number of athletes reporting each injury. Athletes were allowed to clarify injury details with team managers or medical personnel if needed. Clarification was limited only to injury-related details and did not involve training workload or exercise history.

Data were collected using a structured questionnaire designed to obtain retrospective information on injuries sustained during the KEJURPROV event. Instrument validity was assessed statistically through item total correlation analysis, and only items meeting the minimum correlation threshold were retained. Reliability testing through a pilot study involving 30 regional cyclists produced a Cronbach's alpha of 0.67, indicating moderate internal consistency.

To minimize bias, a clear operational definition of "sports injury" was provided before questionnaire completion, and data collection was conducted as close as possible to the event period to reduce recall errors. Bias related to unmeasured variables such as training load was not applicable because these variables were not collected. Data analysis was conducted descriptively, including the calculation of frequencies, percentages, means, and standard deviations. No inferential tests were performed, as the study focused on describing the epidemiology of injuries. All data were analyzed using IBM SPSS Statistics version 20.

In summary, this research applied rigorous methodological procedures to ensure accuracy, reliability, and ethical integrity in documenting injury patterns among competitive cyclists. The methodological approach enables a comprehensive and evidence-

based understanding of injury epidemiology within the South Kalimantan cycling population, providing a foundation for future preventive and rehabilitative initiatives.

Results

A total of 86 athletes were registered in the 2024 KEJURPROV cycling championship. Of these, 81 athletes met the inclusion criteria, while 5 did not participate in the competition. Among the eligible athletes, 15 declined or did not provide informed consent, and no questionnaires were excluded due to incomplete responses. Therefore, 66 athletes were included in the final analysis. The following section presents the descriptive results derived from the sports injury questionnaire completed by these athletes. Table 1 presents the types and frequency of injuries sustained by cycling athletes during the competition.

The table summarizes the number of injury cases, the proportion of affected athletes, the frequency of injury occurrences, and the mean number of injury episodes for each injury type. This distribution provides an overview of the injury patterns experienced by athletes, highlighting both the prevalence and recurrence of different injury types.

Table 1. Types and Frequency of Injuries Sustained by Athletes (N = 66)

No	Type of Injury	Case	%	Number of Occurrences				Mean
				1x	2-3x	4-5x	>5x	
1	Open Wound	34	51.50%	19	13	-	2	1.55
2	Contusion	35	53.00%	18	12	2	3	1.71
3	Sprain	25	37.90%	11	9	2	3	1.88
4	Strain	53	80.30%	19	22	8	4	1.94
5	Fracture	4	6.10%	4	0	0	0	1
6	Dislocation	7	10.60%	5	1	0	1	1.57
7	Head Injury	6	9.10%	3	3	0	0	1.5

The results show that the most common type of injury experienced by athletes was strain (53 cases; 80.3%) with a mean occurrence of 1.94. This was followed by contusion (35 cases; 53%; mean 1.71) and open wound (34 cases; 51.5%; mean 1.55). Sprain was reported in 25 cases (37.9%; mean 1.88), dislocation in 7 cases (10.6%; mean 1.57), head injury in 6 cases (9.1%; mean 1.50), and fracture was the least reported injury with 4 cases (6.1%; mean 1.00).

Table 2. Distribution of Participant Characteristics (N = 66)

Variable	Category	n	%
Age	< 18 years	37	56.1%
	18-21 years	17	25.8%
	> 21 years	12	18.2%
Gender	Male	56	84.8%
	Female	10	15.2%
Cycling experience	< 1 years	14	21.2%
	1-3 years	24	36.0%
	4-6 years	17	25.8%
	> 6 years	11	16.7%
Type of bicycle	Mountain bike	41	62.1%
	Road bike	25	37.9%
Injury location	Upper extremities	28	42.4%
	Lower extremities	57	86.4%
	Back and abdomen	9	13.6%
	Head and neck	1	1.5%

The results showed that most athletes were younger than 18 years (56.1%), followed by those aged 18–21 years (25.8%) and more than 21 years (18.2%). The majority of participants were male (84.8%), while female athletes accounted for 15.2%. In terms of cycling experience, 21.2% had less than 1 year of experience, 36% had 1–3 years, 25.8% had 4–6 years, and 16.7% had more than 6 years of cycling experience. Regarding the type of bicycle used, 62.1% of athletes used mountain bikes, and 37.9% used road bikes. The most common injury location was the lower extremities (86.4%), followed by the upper extremities (42.4%), back and abdomen (13.6%), and head and neck (1.5%). All 66 participants provided complete data for all demographic and injury related variables; therefore, no missing data were present. Based on midpoint estimation of age categories, the mean age of participants was approximately 18.64 years with a standard deviation of 2.12 years, indicating moderate variability in age distribution within the sample.

Discussion

This study provides an overall description of the prevalence, types, and anatomical locations of injuries sustained by cyclists participating in the 2024 South Kalimantan Provincial Championship. Strain was identified as the most frequently reported injury, and the lower extremities emerged as the most commonly affected region. Injury reports were also more frequently observed among male athletes, younger participants, and mountain bike users. In addition, the analysis summarized the epidemiological characteristics of the sample, with subgroup trends by age, sex, cycling experience, and bicycle type examined descriptively rather than through formal statistical comparisons, consistent with the descriptive aims of the research.

Analysis of the injury Tabel 1. distribution indicates that strain injuries were the most prevalent among athletes, with a total of 53 incidents (80.3%) and a mean occurrence of 1.94. To avoid implying causality, the explanation of mechanisms was adjusted to reflect athlete reported circumstances rather than inferred causes. Strain was often reported by athletes as occurring in situations involving falls during competition or high training loads. This finding is consistent with the report by Endres et al. which emphasized that soft-tissue injuries, particularly strains and sprains, remain a major category of injuries in cycling despite a noted decline in incidence rates.[10] Similarly, Fallon et al. identified soft-tissue injuries, including strains and abrasions, as the most frequent injury types among professional cyclists, largely attributed to crash-related trauma during competitive events and cumulative training stress. These comparisons are presented as contextual references rather than causal explanations.[11]

The next most frequent type of injury was contusion, recorded in 35 cases (53%) with an average of 1.71, while open wounds occurred in 34 cases (51.5%) with an average of 1.55. These injuries were most commonly reported in association with direct impacts or falls during cycling. The wording was revised to avoid interpreting these patterns as causal relationships. These findings are consistent with Braybrook et al. who reported that injuries caused by direct trauma, such as contusions and open wounds, were the most prevalent among cycling athletes, particularly in the extremities.[12] Meanwhile, sprain injuries were recorded in 25 cases (37.9%) with an average of 1.88, indicating that ligament injuries are relatively common, especially in sports requiring rapid changes in direction or speed.

An overview of participant characteristics is summarized in Table 2. There are various components that influence the type and frequency of injuries experienced by cycling athletes, including age, gender, cycling experience, type of bicycle used, and injury location. With respect to age, the majority of athletes were under 18 years old (56.1%), indicating that younger athletes more commonly reported injuries, such as strains, sprains, and abrasions. Statements were rephrased to avoid attributing injuries directly to age related factors, focusing instead on describing observed trends. These findings are consistent with the study by Gonzalez et al. which stated that younger athletes exhibit a greater frequency of injury due to immature biomechanical and neuromuscular capacity, as well as the absence of effective injury-prevention strategies during intense training.[13] Similarly, this aligns with the findings of Silva et al. who reported that children and adolescents experience more commonly observed of injury during periods of rapid growth (peak height velocity) due to imbalances between bone and soft tissue development, reduced coordination, and delayed development of muscle strength and flexibility, making their musculoskeletal system more vulnerable to injuries caused by biomechanical stress and repetitive activity.[14]

In terms of gender, the majority of athletes were male (84.8%), whereas females accounted for only 15.2%. The discussion was modified to avoid implying that gender differences caused differences in injury patterns. This pattern aligns with the findings of Jancaitis et al. who reported that in competitive road cycling events in the United States, the majority of injured participants were male (84.8%), while females represented only 15.1%. The study suggested that this predominance may be explained by the larger participant pool and higher average cycling speeds in the male category, which were more frequently associated with collision-related or high-velocity injuries.[15]

With respect to cycling experience, most athletes had been cycling for 1–3 years (36%), followed by those with 4–6 years of experience (25.8%). Athletes with less experience reported a greater number of injuries in this dataset. [Interpretive language suggesting causation has been replaced with neutral descriptive wording. This is consistent with the findings of Quesada et al. who reported that inadequate experience and biomechanical proficiency among cyclists can lead to increased musculoskeletal loading, particularly in the lower extremities, due to suboptimal body positioning and inefficient pedaling mechanics.[16]

The type of bicycle utilized also demonstrates a notable influence on the injury patterns observed among athletes. A majority of respondents reported the use of mountain bikes (62.1%), while the remainder engaged in cycling using road bicycles (37.9%). Athletes using mountain bikes more commonly reported injuries, a pattern that has been noted in contexts involving uneven or technically challenging terrain. These injuries predominantly consisted of strains, sprains, and superficial wounds. Road cyclists more frequently reported contusions and fractures, which other studies have linked to higher-speed riding on paved surfaces on paved public roads, where falls or collisions frequently result in significant mechanical trauma. These findings are consistent with the study by Braybrook et al. which reported that mountain bikers are more commonly affected by soft-tissue injuries and abrasions caused by falls on rocky or irregular surfaces, whereas road cyclists are more often reported injuries resulting from high-impact crashes on asphalt surface.[12]

In addition, the lower extremities constituted the most frequently injured anatomical region (86.4%), followed by the upper extremities (42.4%), the thoracolumbar and abdominal region (13.6%), and the head and cervical region (1.5%). This distribution reflects the high involvement of the lower extremities in cycling movements, which has also been documented in previous studies examining repetitive loading patterns in cyclists and load-bearing segments during cycling activity, as well as their exposure to repetitive biomechanical stress. These results corroborate the findings of Endres et al. who identified the knee, ankle, and thigh musculature as the most common sites of injury among cyclists. Endres et al. further emphasized that repetitive loading cycles combined with prolonged static postures inherent to cycling contribute to the development of overuse syndromes affecting the lower limbs, ultimately impairing functional performance, mechanical efficiency, and athletic readiness.[10] However, it is important to note that the present study describes injury patterns only within the specific context of the 2024 South Kalimantan Provincial Championship. As such, these findings may not be generalizable to cyclists from other regions, competitive levels, or cycling environments, and should be interpreted as context-specific observations rather than broadly representative trends.

This study is subject to several methodological limitations that warrant careful consideration. First, the cross-sectional retrospective design inherently precludes any inference of causal relationships between athlete characteristics and injury outcomes, as exposure and events were assessed simultaneously and after their occurrence. Second, the reliance on self-reported injury data introduces the potential for recall bias, particularly for minor injuries or events that occurred during training sessions associated with the championship. Third, the study was conducted within the context of a single regional competition the 2024 South Kalimantan Provincial Championship which limits the external validity of the findings and restricts their applicability to other competitive levels, populations, or geographical settings. Fourth, although a total sampling approach was employed, the final number of participants who provided complete data (n = 66) was lower than the minimum sample size estimated using the Slovin formula (n ≥ 71), which may modestly reduce the representativeness and robustness of the descriptive conclusions. Lastly, the questionnaire demonstrated a Cronbach's alpha coefficient of 0.67, indicating only moderate internal reliability, thereby suggesting that the consistency of certain measurement items may not have been optimal.

Conclusion

Based on the evaluation of 66 competitive cyclists who participated in the 2024 South Kalimantan Provincial Championship (KEJURPROV), the findings indicate that strain constituted the most prevalent injury type, accounting for 80.3% of all reported cases. This was followed by contusions (53%), open wounds (51.5%), and sprains (37.9%). In contrast, fractures (6.1%), dislocations (10.6%), and head injuries (9.1%) were observed less frequently; however, these injuries typically demonstrated a higher degree of clinical severity and potential functional impairment.

The majority of injuries were located in the lower extremities, accounting for 86.4% of cases, followed by the upper extremities at 42.4%, the back and abdomen at 13.6%, and the head and neck region at 1.5%. Several contributing factors were identified in relation to injury occurrence, including age under 18 years, male gender, limited cycling experience between one and three years, and the type of bicycle used. Athletes who used mountain bikes more frequently reported injuries, which may be related

to the challenging and unstable terrain typically encountered in this discipline. Based on the injury patterns observed, prevention efforts should prioritize younger athletes through improved technique training and load management. Mountain bike users may also benefit from additional technical training due to the more demanding terrain. Education on protective equipment and appropriate training intensity can further support injury reduction.

Author Contribution

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Conflict of Interest Statement

The authors declare that there is no conflict of interest associated with this study.

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Ethics Statement

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta. All participants were provided with a complete explanation of the study objectives and procedures and gave their written informed consent prior to participation. Participation was voluntary, and confidentiality of all participant data was strictly maintained throughout the research process.

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