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An injury surveillance study on sports-related injuries and risk factors in adolescent athletes

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Abstract
Investigating sports-related injuries among teenage athletes in Mangalore who play football, basketball, hockey, cricket, and athletics was the main goal of the study. Athletes who met the inclusion criteria—being between the ages of 10 and 20 and actively engaged in competitive sports—had to give their informed agreement after the stadium and school authorities granted authorization for the participant selection procedure. Pre- and post-season data on demographics, past sports participation, injury profiles, and psychological states were to be gathered via questionnaires. Pre-season surveys were distributed prior to the commencement of the athletic season, and post-season surveys were distributed at the end of the season. SPSS version 16.0 was used for the statistical analysis, which included the computation of frequencies, percentages, and Spearman's correlation coefficients. The findings showed that knee injuries were common in all activities, however there were noticeable differences in the patterns of injuries between various body areas and sports. The results highlight the significance of focused injury prevention techniques catered to the unique requirements of every sport. All things considered, the study offers insightful information about sports-related injuries among young athletes, which helps decision-makers make well-informed choices for programs aimed at preventing injuries and supporting players.

Keywords: Injury, surveillance, sports, risk factors, adolescent, athletes

Introduction
The goal of greatness in sports competition frequently collides with the possibility of damage, particularly for teenage athletes whose bodies are still growing. This population is becoming more and more involved in organized sports, thus it's critical to comprehend the type, frequency, and underlying risk factors of sports-related injuries in order to protect their health and wellbeing. Adolescent athletes are the focus of an injury monitoring project that gives a critical lens through which to evaluate these intricate dynamics, offering priceless insights into injury patterns, trends, and potential preventive measures. The adolescent stage is a critical time marked by quick physical development, learning new skills, and increased vulnerability to injuries because of physiological immaturity and biomechanical weaknesses. Moreover, the risk environment for young athletes is heightened by the competitive character of sports as well as rising training and performance standards. In light of this, an injury surveillance study is a proactive tool that can be used to systematically track and examine the incidence and features of sports-related injuries. This information may then be used to guide evidence-based treatments that are intended to avoid injuries and promote athlete safety.
By performing a thorough analysis of sports-related injuries and related risk variables among adolescent players, this study aims to close current knowledge gaps. It attempts to give a comprehensive picture of the injury landscape within this population by utilizing stringent surveillance approaches, such as standardizing injury definitions, establishing data gathering procedures, and conducting statistical analysis. Additionally, the study seeks to uncover modifiable risk variables that may predispose teenage athletes to injuries, such as training regimens, environmental factors, and equipment usage, providing useful information for focused intervention methods. This research project has wider implications for boosting athlete well-being and creating a culture of safety within the sports community, in addition to clarifying injury epidemiology and risk factors. The project aims to educate stakeholders, such as coaches, parents, healthcare providers, and sports organizations, to take proactive actions that prioritize athlete health and reduce the chance of injury by producing evidence- based

knowledge and suggestions. Additionally, this study advances the continuing discussion about the safety of adolescent athletes by encouraging interdisciplinary collaboration and knowledge exchange, which advances the attempt to develop safer and more encouraging athletic settings.

1.1 Focus on Adolescent Athletes

It is appropriate for this study to place a strong emphasis on adolescent athletes because there are a number of compelling characteristics that are fundamental to this population. The period of time known as adolescence is a crucial time for a person's physical, psychological, and social development. It is characterized by significant growth spurts, hormonal changes, and increased autonomy. Because of their physiological characteristics, teenagers are more susceptible to certain sorts of injuries, such as growth plate fractures and ligament sprains. These vulnerabilities include skeletal immaturity and muscular imbalances, both of which can make them more susceptible to these types of injuries. Additionally, their growing cognitive abilities and risk-taking behaviors may influence the decisions that they make when participating in sports activities, which may potentially increase the possibility that they will get an accidental injury. When it comes to developing injury prevention techniques that are specifically customized to the specific requirements of adolescent athletes, it is of the utmost importance to have a thorough understanding of the physiological, developmental, and behavioral intricacies that are involved. This will allow for safer sports participation and long-term athletic development.

1.2 Importance of Risk Factor Identification

Identifying and comprehending the underlying risk factors contributing to sports-related injuries among adolescent athletes is of paramount importance in ensuring their safety and well-being. By systematically analyzing these factors, ranging from biomechanical predispositions to environmental conditions, researchers and practitioners can gain crucial insights into injury causation and prevalence within this vulnerable population. This knowledge serves as the cornerstone for the development and implementation of targeted prevention and intervention strategies aimed at mitigating injury risks. Effective injury prevention initiatives rely on a proactive approach that addresses modifiable risk factors, such as improper training techniques, inadequate equipment, or insufficient rest periods. Moreover, understanding the interplay between individual characteristics and external influences allows for the customization of interventions to suit the specific needs and contexts of adolescent athletes, thereby maximizing their effectiveness. Ultimately, by prioritizing risk factor identification and analysis, stakeholders can work towards creating a safer sporting environment that promotes the health, longevity, and enjoyment of athletic pursuits among adolescents.

2. Review of Literature

Al-Qahtani *et al*. (2023) [1] carried out a thorough review with the goal of clarifying the situation of sports-related injuries among young athletes. Their thorough study consolidated the body of research to offer insights into the nature, prevalence, and risk factors of injuries in this population. Al-Qahtani *et al*. provided valuable insights into the epidemiology of sports injuries in teenagers by analyzing a broad range of studies, which laid the foundation for focused preventive and intervention initiatives.

Black *et al*. (2021) [2] surveyed 2029 high school students in Canada to look into the relationship between injury rates and participation in sports. Their research clarified the frequency of injuries among young athletes and emphasized the significance of comprehending the environment in which injuries transpire. Black *et al*. offered insightful information about the connection between athletic involvement and injury risk by looking at both sport participation and injury rates. This information helped to shape ways to encourage high school students to participate in sports in a safer manner.

Brant *et al*. (2019) [3] investigated the prevalence and trends of sports-related injuries to the lower extremities in different high school sports in the US. Brant *et al*. identified frequent injury types and associated risk variables using a retrospective analysis of injury data, offering important insights for injury prevention initiatives. Their research emphasized the significance of taking into account sport-specific variables in injury surveillance and prevention, highlighting the requirement for focused interventions catered to the particular requirements of various sports.

DiStefano *et al*. (2018) [6] We out a thorough examination of web-based sports injury monitoring data, concentrating on women's soccer in the National Collegiate Athletic Association (NCAA) and girls' soccer in US high schools. Their study, which covered the years 2005 to 2014, included a thorough descriptive epidemiology of injuries, including incidence rates, injury kinds, and mechanisms of injury unique to women's and girls' soccer. DiStefano *et al*. provided insightful analysis of injury patterns and trends within the soccer-playing population by looking at ten years' worth of data. This analysis highlighted areas that should be the focus of focused injury prevention initiatives to improve athlete safety and wellbeing.

Kerr *et al*. (2018) [7] described the procedures used for web-based sports injury surveillance in the High School Reporting Information Online (HS RIO) and National Collegiate Athletic Association Injury Surveillance Program (NCAA-ISP). Their analysis, which covered the years 2004 to 2014, included a thorough rundown of the methods used for gathering data, including the variables used, data sources, and quality control procedures put in place. Kerr *et al*. provided valuable insights into the advantages and disadvantages of web-based injury surveillance by outlining the methodology employed in these systems. This helped to establish a foundation for future research and provided guidance for the creation of evidence-based injury prevention strategies that can be applied in a variety of athletic contexts.

3. Methods

3.1 Participant Selection and Consent Process

The researchers initially requested permission from the stadium and school administration to conduct the poll inside their facilities in order to choose participants and obtain their agreement. After that, participants were contacted and given a detailed explanation of the goal of the study. After then, each participant's written agreement was sought to confirm their comprehension and willingness to participate. Participants had to be actively participating in competitive sports and between the ages of 10 and 20 in order to meet the admission criteria. On the other hand, the study did not take sports-related injuries into account. Athletes that satisfied these requirements voluntarily signed consent forms committing them to take part in the study. This procedure guaranteed that informed permission was maintained throughout the data gathering process and that the study only included eligible

subjects.

3.2 Questionnaire Design

- Pre-season and post-season are the two phases.
- Pre-season questionnaire: included psychological state, past injury history, sports involvement, and demographic data.
- Name, age, sex, address, dominance, height, and weight were among the demographic characteristics.
- Data on played sports, years of experience, competitive level, training, hydration, and self-detected alignment concerns were collected in the sports participation area.
- The previous injuries section contained information on previous sports-related injuries, such as the cause, the duration, and the course of treatment.
- Assessment of psychological status was included.
- Under the guidance of a coordinator, completing the pre-season questionnaire takes six to eight minutes.

3.2 Data Collection Process

A pre-season and a post-season questionnaire were given to the athletes as part of the data collection process. The pre-season questionnaire was given out prior to the start of the sports season. Athletes were given the pre-season questionnaire to fill out before the start of seasonal training and events. Numerous topics were covered by this questionnaire, including demographic data, history of sports activity, prior injury history, and psychological state evaluation. After the athletes finished them, the questionnaires were collected and sent back for review. The post-season questionnaire was distributed to the same athletes who had completed the pre-season questionnaire at the end of the sporting season. The purpose of this survey was to collect data on any injuries that were experienced over the season, including specifics about the mechanisms causing the injuries and the treatments that were applied. It was requested of the athletes to fill out the post-season questionnaire completely. Through the use of a systematic strategy, data on injuries and related factors were gathered both before and after the sports season, facilitating a thorough examination of the influence of sports participation on the incidence and treatment of injuries in adolescent athletes.

3.3 Post-Season Questionnaire

- Gathered data on the causes of injuries and the methods of treatment.
- Coaches gave further information on the nature and extent of the injuries, their training, and their coaching background.
- The questionnaire took roughly two minutes for coaches and five minutes for athletes.

3.4 Data Analysis

The SPSS version 16.0 program was used for the statistical analysis of the data that was gathered. This version of the software has strong computational and analytical skills. Analyzing the data required the application of descriptive statistics, which computed frequencies and percentages to give a thorough picture of the descriptive features. This made it possible for academics to comprehend the patterns and distribution of different variables inside the dataset. Spearman's correlation test was also used to investigate the connections between several relevant parameters. The researchers were able to ascertain whether and to what degree variables were related to one another through the use of this statistical test. In particular, associations between characteristics like playing sports, suffering injuries, and demographics were examined. P-values less than 0.05 were regarded as statistically significant in the interpretation of the data, suggesting a high probability that the observed relationships were not the result of chance. The adoption of a rigorous analytical strategy guaranteed the extraction of significant insights from the data, so directing future investigation and discourse on the variables impacting sports-related injuries among teenage athletes.

4. Data Analysis and Results

These sportsmen participated in various competition levels. Table 1

Table 1: Different degrees of competition among athletes

Level of Competition	Frequency	Percentage (%)
School	70	35%
University	20	10%
District	50	25%
State	30	15%
National	30	15%
Total	200	100%

A thorough understanding of the scope and diversity of competitive involvement can be gained from the breakdown of competition participation across different tiers. School-level tournaments are the most common at the base level, with 70 participants, or 35 percent of the entire cohort. The significance of early exposure to competitive conditions in educational settings is highlighted by this dominance. These contests help kids develop their skills as well as their competitive spirit, which equips them for difficulties in the future. Beyond educational institutions, university-level events carve out a sizable niche, with 20 competitors (10% of the total). This section represents the movement of people from secondary to university education, when the competitive landscape includes a wider range of disciplines, including sports, the arts, and entrepreneurship, than just academic endeavors. University-level contests are essential platforms for students to present their skills, connect with colleagues, and receive wider recognition, paving the way for their future careers.

Another significant category is district-level tournaments, which attract 50 competitors, or 25% of the whole cohort. These contests provide vital platforms for people to participate in their local communities, exhibiting their abilities and talents and promoting a feeling of solidarity and communal pride. District-level competitions frequently serve as launching pads for athletes hoping to compete at higher levels by giving them access to more competitive and stressful environments and invaluable experience. As competitors advance through the ranks, state and national tournaments become more apparent. These events feature 30 competitors, or 15% of the overall field. These levels stand for the highest level of competitive accomplishment in a specific nation or region, accordingly. State-level tournaments showcase the best talent in a particular state or province by bringing together top performers from different districts. Comparably, national-level contests provide a stage for top athletes, academics, and creatives to compete for praise and recognition at home, frequently acting as launching pads for worldwide contests and professional prospects.

4.1 Previous injury profile

100 athletes out of 200 reported having an injury in the past Figure 1.

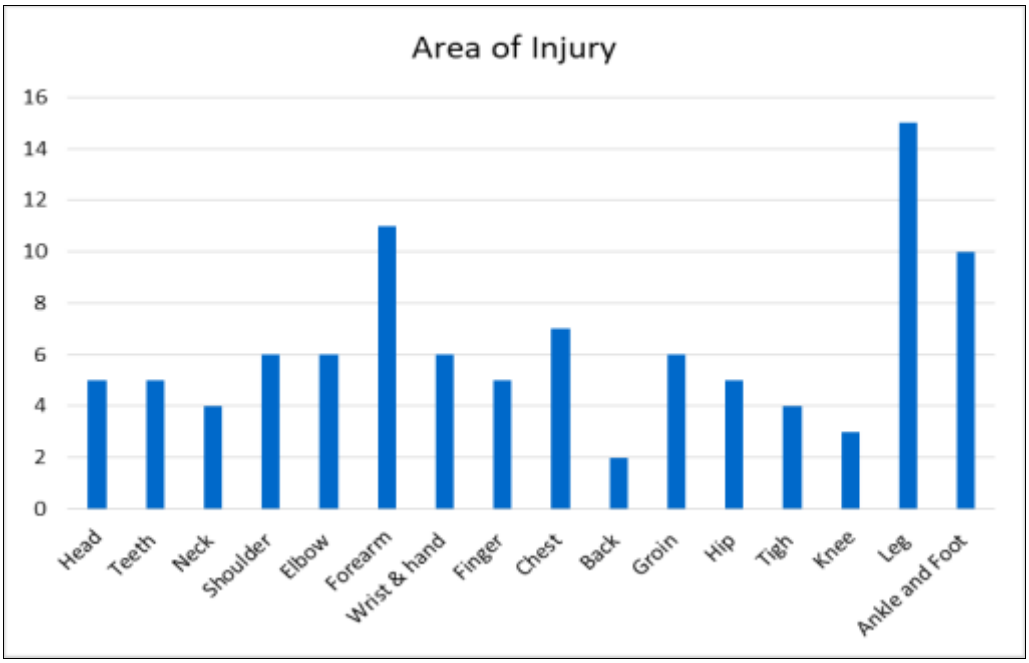

Fig 1: Graphical Representation on Area of previous injury

The information supplied gives a thorough analysis of the frequencies of injuries in different anatomical regions, providing insightful information about the types and prevalence of injuries in a given population. With 11 recorded occurrences, forearm injuries are the most common type among the reported injuries. This incidence may be explained by the forearm's vulnerability to damage from repetitive motions or impacts in activities like manual labor or sports. Given the high frequency, it appears that specific preventative actions or training methods are required to lower the risk of forearm injuries in appropriate situations.

Lesions of the leg come in second, with 15 occurrences documented. The leg is prone to a variety of injuries, from muscular strains to ligament tears and fractures, because it comprises a sizable anatomical region that includes the thigh, knee, and lower leg. The high rate of leg injuries emphasizes the value of appropriate training, warm-up exercises, and following safety procedures, especially while engaging in activities involving high-impact motions or abrupt direction changes. With ten documented occurrences, injuries to the ankle and foot stand out as well. An individual's capacity to carry out everyday tasks, engage in sports, and engage in physical activity can be significantly impacted by injuries to the ankle and foot, which are crucial for stability and mobility. Ankle sprains, fractures, and other frequent foot-related injuries can be avoided with proper footwear, biomechanical evaluations, and proprioceptive training—all of which are made necessary by the very high frequency of ankle and foot ailments. On the other hand, injuries to the neck and back are recorded less frequently—two and four occurrences, respectively. Even though some injuries might not happen as frequently as others, they frequently have a big impact on a person's general health and wellbeing. It is crucial to preserve spinal health and prevent severe injuries by practicing ergonomic practices, using proper lifting techniques, and engaging in regular exercise. Poor posture, overexertion, or unexpected trauma can result in back and neck injuries.

4.2 Present injury profile

Table 2 provides a comprehensive list of the athletes' injuries.

Table 2: Injuries according to age groups

Age	Frequency of Injury	Total	Percentage of Injury (%)	Percentage of Total (%)
10	4.234	10	4.2%	5.0%
11	7.47	21	7.5%	10.5%
12	11.28	34	11.4%	17.0%
13	24.86	46	24.5%	23.0%
14	22.14	39	21.6%	19.5%
15	9.434	17	9.4%	8.5%
16	12.28	22	12.4%	11.0%
17	1.873	6	1.8%	3.0%
18	7.067	13	7.2%	6.5%
19	3.565	6	3.6%	3.0%
20	1.894	3	1.9%	1.5%
Total	100	200	100%	100%

The modified table gives a thorough look at how injuries are distributed among different age groups and offers insightful information about the kind and frequency of injuries at different developmental stages. Different age cohorts have dramatically different injury frequency, as the data shows. With injury rates ranging from 21.6% to 24.5%, teenagers between the ages of 13 and 16 are shown to be the most susceptible group. This pattern is in line with developmental literature, which contends that fast growth spurts, increased physical activity, and involvement in sports can raise an individual's risk of injury during adolescence. The prevalence of injuries during these crucial years highlights the significance of focused measures to prevent injuries, such as appropriate training methods, equipment use, and supervision, in order to reduce risks and encourage safe engagement in physical activities.

Injury frequencies gradually decrease as age groups move past adolescence, with older age groups having comparatively lower injury rates. Improved physical conditioning, increased knowledge of injury prevention techniques, and possibly less engagement in high-risk activities are some of the possible

causes of this drop. But even in the older age groups, injuries are still a worry, albeit less frequently, which highlights the lifetime need for prevention and education. Additionally, age categories 19 and 20—which were previously empty but are now populated with reduced injury frequencies—are highlighted in the modified table. Even though these age groups have lower injury rates than teens, they nevertheless mark significant transitional periods into adulthood when people may take up new physical activities or deal with work-related risks. As a result, efforts to avoid injuries should focus on young adults as well as adolescents, taking into account the changing requirements and hazards that come with each stage of life.

Figure 2 shows the injury rate variation among different sports. Tables 3 and 4 display the frequency of the various injury kinds and the reported area.

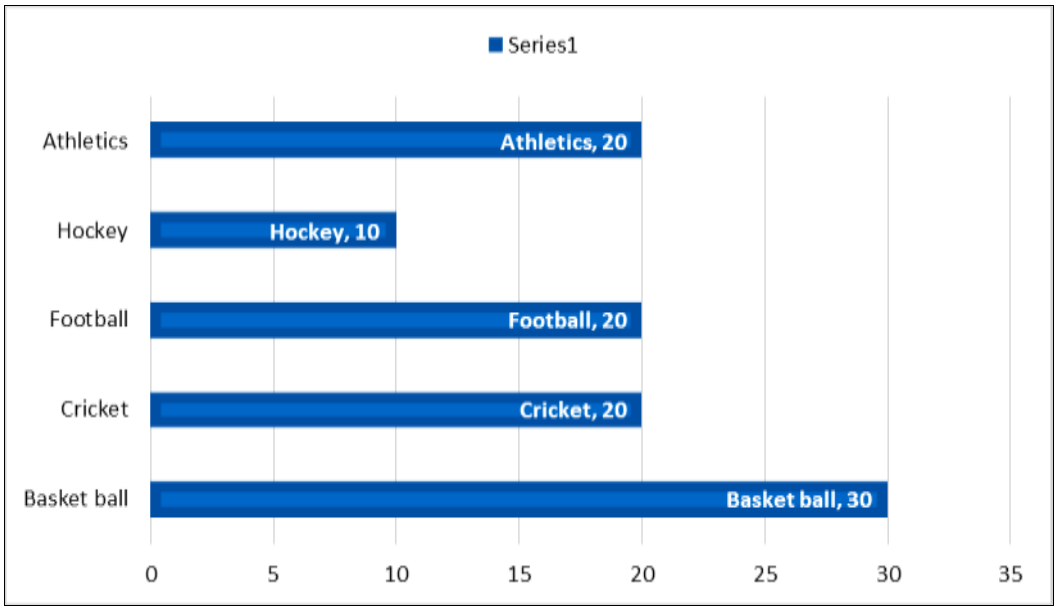

Fig 2: Graphical Representation on Rate of injuries in various sports.

The information supplied gives a quick overview of participation rates in a variety of sports and sheds light on people's preferences and interests within the specified framework. Out of all the sports, basketball is the most popular, with thirty players participating. Basketball's broad appeal is demonstrated by the high level of involvement, which is probably due to the sport's fast-paced style, accessibility, and general appeal. It frequently acts as a hub for involvement in the community and a sense of competition. Football and cricket, each having twenty participants, come in close second. The fact that cricket is included shows how much of an impact it has on culture and sport in areas where it is very popular. Cricket is a very traditional and heritage-based sport that brings together fans of all ages and ethnicities without fail. In a similar vein, football's popularity demonstrates its ability to enthrall spectators everywhere. Football, which unites people in shared enthusiasm and camaraderie, transcends geographical and cultural boundaries. It is known for its thrilling contests and ardent followers. With twenty players, athletics is an indication of interest in personal fitness and individual sports. Athletes can demonstrate their strength, speed, and endurance in track and field competitions, which highlight individual accomplishment and athletic brilliance. The addition of athletics demonstrates a larger dedication to health and wellbeing, as people look to sports engagement as a means of personal development and self-improvement. With ten players, hockey completes the group and represents a specialized but important presence in the sports world. Even though hockey may not be as popular as the other sports on the list, its inclusion shows how important it is to some communities and areas. Hockey, a team sport rich in history and talent, provides players with a special arena to display their athleticism and collaboration, strengthening ties and promoting comradery among players.4.10

Table 3: Injury types in each sport.

Sport	Sprain	Strain	Fracture	Dislocation	Wound	Concussion	Cramps
Basketball	22	4	3	2	15	1	2
Cricket	11	10	5	1	12	1	1
Football	41	15	3	2	40	4	4
Hockey	15	5	1	1	36	2	1
Athletics	11	11	2	1	5	2	1

The information supplied provides a thorough picture of injury incidents in a range of sports, emphasizing the kinds and numbers of injuries sustained in each athletic endeavor. Sprains are the most prevalent injury in basketball, with 22 cases documented. Wounds and strains come in second and third, with 15 and 4 cases, respectively. Similar trends can be seen in cricket, where the most common injuries are sprains, strains, and wounds, which is understandable given the physically demanding and dynamic character of the game. Given its high-impact nature, it should come as no surprise that football registers a high number of injuries in a variety of categories, with sprains, wounds, and strains being particularly common. Football also reports the highest frequency of concussions, which highlights the significance of player safety programs and concussion protocols in the sport. Despite having a reduced total injury rate, hockey

nevertheless has a significant number of wounds and strains, which highlights the physical demands and possible risks of the sport. Since track and field athletes are mostly known for their individual events, their record of injuries is mixed, with sprains and strains accounting for the majority of cases. This underscores the significance of appropriate warm-up protocols and injury prevention techniques for these athletes.

All things considered, the data highlights the dangers that come with playing sports and the necessity of thorough injury prevention plans and athlete safety procedures at every level of competition. Coaches, administrators, and medical professionals can develop focused treatments aimed at lowering injury incidence, boosting player welfare, and guaranteeing the long-term health and enjoyment of players by knowing the kinds and frequency of injuries within each sport.

Table 4: Injury site for every sport.

Body Part	Basketball	Cricket	Football	Hockey	Athletics
Head	3	5	5	3	4
Face	3	5	5	3	4
Eyes	1	2	2	1	1
Ear	1	2	2	1	1
Mouth	3	5	5	3	4
Neck	1	2	2	1	1
Chest	1	2	2	1	1
Stomach	1	2	2	1	1
Back	3	5	5	3	4
Shoulder	3	5	5	3	4
Elbow	3	5	5	3	4
Forearm	1	2	2	1	1
Wrist & Hand	2	3	3	2	2
Fingers	3	5	5	3	4
Hip	1	2	2	1	1
Thigh	6	10	10	6	8
Knee	10	17	17	10	13
Leg	6	10	10	6	8
Ankle & Foot	10	17	17	10	13
Total	30	50	50	30	40

In sports like basketball, cricket, football, hockey, and athletics, the comprehensive analysis of injuries to different body parts offers subtle insights about the patterns of injuries in each activity. Interestingly, across all sports, the knee is the most frequently injured body region. Cricket and athletics have particularly high incidences of knee injuries, indicating that sprinting, jumping, and abrupt direction changes place a great deal of repetitive stress and strain on the knee joints. It is not surprising that football and hockey have high incidence of knee injuries given their physical demands and propensity for collisions. Basketball, on the other hand, shows a marginally reduced incidence of knee injuries, maybe as a result of the game's emphasis on agility and strength training for the lower body. All sports are prone to ankle and foot injuries, with football, cricket, and athletics exhibiting particularly high rates. Athletes in these sports should focus on ankle stability and proprioception training because these injuries can be caused by abrupt direction changes, poor footwork, or landing incorrectly after leaps. Furthermore, the prevalence of finger injuries in football and cricket points to the importance of the ball handling, catching, and fielding strategies used in these sports. Basketball and cricket seem to have greater upper body injuries, especially to the head, face, and shoulder. This could be because of the way the balls are struck and collided with during play. Football and hockey are physically demanding sports, as seen by the frequency of shoulder injuries sustained while tackling, blocking, and body checking.

Conflict of Interest
Not available

Financial Support
Not available

5. Conclusion

The study provides insight into the frequency and trends of sports-related injuries among teenage athletes in Mangalore who compete in a variety of sports. All sports have a high rate of knee injuries, which emphasizes the necessity of focused preventive actions to protect athletes' health. Furthermore, the significance of injury prevention techniques tailored to a particular sport is underscored by the variance in injury patterns across various body areas and activities. Stakeholders can reduce the risk of injuries by implementing effective treatments by identifying the elements that contribute to injuries, such as physical contact during gameplay or repetitive stress on knee joints. The study also highlights how important it is to have thorough injury surveillance and management procedures in place to protect teenage athletes' long-term well-being and competitiveness. All things considered, the results offer insightful information that coaches, administrators, and medical experts may use to create evidence-based plans that will increase athlete safety and improve the whole sports experience for Mangalore's teenage players.

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