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General

Track and field-related lower-extremity musculoskeletal injuries: A retrospective study discussing injury analysis, stressors, and comprehensive management

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Objective

This study aims to provide beneficial information, from a clinical perspective, on how healthcare providers and sports educators can navigate treatment and safety for TAF athletes. This was done by identifying trends seen in lower-extremity TAF injuries and providing potential treatments to counter specific injuries, closing gaps in current literature.

Methods

The National Electronic Injury Surveillance System (NEISS) database was queried during a ten-year time span (2014-2023) to analyze lower-extremity track and field-related musculoskeletal injuries.

Results

There were 128,761 cases reported in the Emergency Department from 2014-2023. Fifty eight percent occurred in females compared to only 42% in males, making females 1.4 times more likely to experience injury. Most injuries took place in 2017. Most cases in adolescents were aged 15 and 14 years old. The 10-19 age group had disproportionately more cases. 1,067 reported cases of strain/sprains were associated with female patients with 733 cases present in males. Strain/sprains ranked the highest, followed by fractures, excluding other/not stated cases. The ankle was the body part with the most cases, followed by injury to the knee.

Conclusions

As a widely popular sport, future studies should look at providing a more comprehensive characterization into how a patient's specific demographics may play into injury detection and prevention.

INTRODUCTION

Track and field (TAF) has continued to prevail as a popular chosen recreational and competitive sport within a variety of age ranges, clustered among adolescents. With many different events to choose from, the dynamism within the activity allows for individuals to compete in short-distance running, long-distance running, and field related areas. A publication from the Statisica Research Department reported the number of participants in track and field to be approximately 4.14 million in the US, with participants typically being ages six years and older.[1] The variability of the sport results in different training regimes unique to each individual event, which tend to result in a plethora of stressors that are niche to each subsection of the sport. However, an overarching trend within the activity has presented that 64% of athletes have suffered at least one injury with 83% of all studied injuries being located in the lower extremities.[2] This frequency has caused track and field to be ranked as the third most frequent sport with injuries focused in lower regions compared to other traditional sports.[3] To better understand this correlation, a keen understanding of the fundamentals of track and field training is required, along with runners' motivation and the benefits of the exercise.

Although athletes may face consistent setbacks from injuries, participation in TAF training programs have been seen to have significant benefits for the health and physical fitness of individuals, especially for adolescents. As a sport that has significant stressors on lower limbs, exercise-based injury prevention programs have demonstrated both positive effects on athletic performance and have been consis-

tent in decreasing lower limb injuries.[4] Youth involvement in sports additionally has been associated with improved psychological and social health beyond other forms of physical activity.[5] As most TAF athletes transition to a lifestyle of leisure time running, the benefits display a significant reduction of cardiovascular mortality independent of individual patient variables (i.e. sex, age, BMI)[6] in addition to being used as a therapeutic tool for a series of adverse psychological conditions (i.e. depression, anxiety, low self esteem).[7] Although a previously unresearched field, TAF injury and prevention informatics hold great benefits for the future of runners and field athletes.

Considering the prevalence of injuries among adolescent and adult athletes, this retrospective study aims to better report on the epidemiology of lower-extremity TAF injuries over the past ten years. By examining the trends seen within the queried data, the study hopes to provide guidance to healthcare professionals regarding the prevalent injury sites, risk factors, and preventative methods that will result in comprehensive management.

METHODS AND MATERIALS

STUDY DESIGN

The National Electronic Injury Surveillance System (NEISS) is a publicly available digital database that the United States Consumer Product Safety Commision formulates. This organization closely tracks and records various traumatic injuries that result in emergency department referrals and occur from consumer products. The NEISS database was queried and analyzed to perform this retrospective study of lower-extremity musculoskeletal injuries that result from track and field sports. To perform this study, track and field was chosen from the Sports and Recreation Equipment section in addition to selecting the Lower-Extremity code which allowed for the analysis of lower region injuries.

STUDY POPULATION

The National Electronic Injury Surveillance System utilizes emergency department data from approximately 100 of the 5,000 hospitals in the United States. For this study, data from the ten-year timespan of 2014 to 2023 was queried for analysis. The database's youngest presented age was two and the oldest was 84 years old. Data was compiled using specific ages with additional evaluation in ten-year age groups. The patient population was not filtered by any categories such as age, sex, or race; all groups were included according to their appropriate measurement. Participants were required to present a lower-extremity track and field-related injury to meet the study's inclusion criteria, which included code 5030. With focus on lower regions, this included the following codes: Knee (35), Lower Leg (36), Ankle (37), Upper Leg (81), Foot (83), and Toe (93). 3,587 track and field incidents were filtered as viable results from the database.

All diagnosis codes were also queried, but only those with numerical values were used in interpretation, including Contusions, Abrasions (53), Dislocation (55), Fracture (57), Laceration (59), Strain, Sprain (64), and Other/Not Stated (71). Disposition codes were analyzed, but only data that had numerical values were used, including if they were treated/examined and released (code 1) and treated and admitted/hospitalized (code 4). Data from specific categories were excluded from this analysis as the NEISS database returned asterisks that represented statistically insignificant values (national cases less than 1,200 or recorded cases less than 20).

STATISTICAL ANALYSIS

This study aimed to understand the patterns and potential preventative methods for lower-extremity TAF-related injuries. To achieve this, we analyzed patient age groups, gender, body parts, injury year, diagnosis, and dispositions related to these injuries. The NEISS database outputs were analyzed using the JMP 18.0.1 software. The authors' findings, based on this rigorous analysis, revealed the gender susceptibility to TAF injuries, the distribution of injuries across different age groups, the commonality of diagnosis in affected individuals, and the importance of follow-up care and preventative methods in reducing injuries.

RESULTS

A total of 128,761 TAF-related lower-extremity injuries were reported in the NEISS database over the span of ten years. 98.6% (n=125,304) of patients who presented with these injuries were reported to be treated/examined and then released, while 1.4% (n=1,750) were treated and admitted/hospitalized.

Figure 1 represents the distribution of lower-extremity TAF injury incidents by age in years. It was seen that the highest frequency of incidents was reported in adolescents with 17,502 injuries reported to patients who were 15 years old and 17,405 injury cases for patients who were 14 years old. During the ages of pre-puberty,[8-11] there was an approximate 1.5-2 time increase with each following age year. The number of incidents halved from ages 17 to 18, followed by a steady continuum of approximately 1,300 cases during the early twenties. Additionally, injuries were also analyzed by ten year age groups, with 10-19 year olds having reported 101,072 incidents. Following a significant decrease, 8,144 reported cases were found in patients from ages 20-29 years with a steady decrease until 1,400 cases reported in patients 60-69 years old.

With the provided data from 2014-2023, the estimated association of incidents has displayed a forward trend, with a significant decrease in 2020. With a peak in 2017 with 17,573 incidents, there has been a mean of approximately 15,438 cases from 2014-2019, excluding 2017. Significantly, there was a decrease in 2020 with 4,716 presented cases with steady growth during the years post-2020. 2021 and 2022 allowed for an approximate 2,754.5 case increase every year with a leveling during 2023. Comparatively, the years post-2020 had a significant reduction of incidents opposed to the late 2010s.

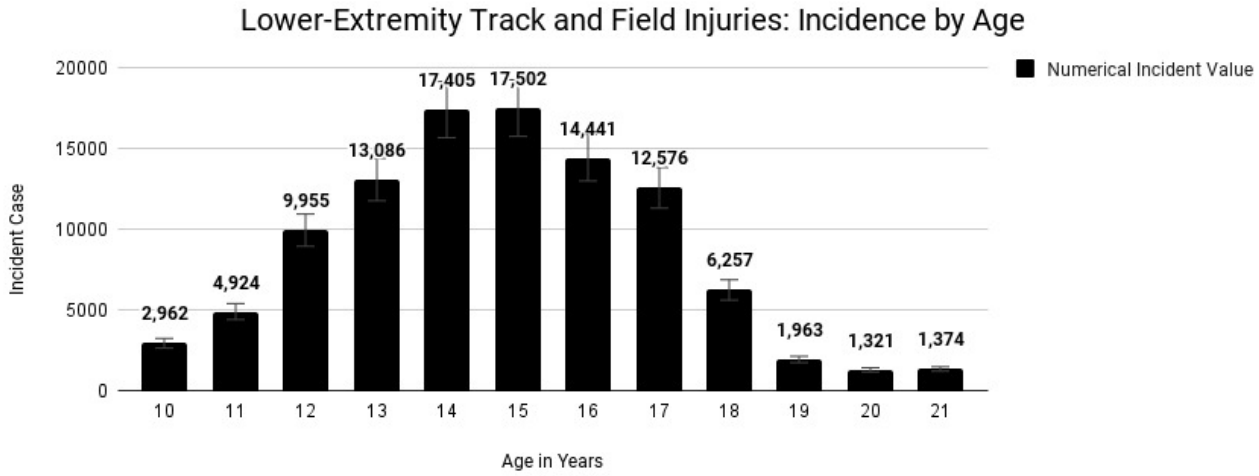

Figure 1. TAF incident cases presented in lower-extremity regions by years from the NEISS database.

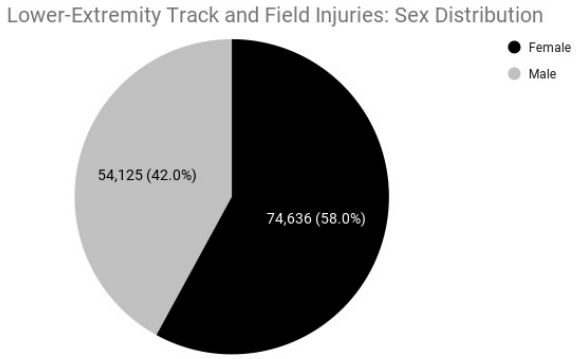

Figure 2. Sex distribution of lower-extremity TAF injuries based on values from the NEISS database.

As displayed in Figure 2, there has been a varied distribution of incidents by sex as 58% (n=74,636) of females reported lower-extremity TAF injuries while only 42% (n=54,125) of males did. Additionally, diagnosis displayed trends as sprains/strains were the most common injury with 49.1% (n=64,165) of patients being represented with these injuries. Following this, 30% (n=39,200) of patients presented with other/not stated injuries. Other classifications of injuries including dislocations, fractures, and contusions/abrasions presented with cases less than 10%.

In Figure 3, diagnosis frequency displayed significant trends in association with patient sex, as 1,067 reported cases of strain/sprains were associated with female patients. This extremity was additionally seen in males, as they presented with 733 cases. Following a similar trend in diagnosis, 607 females and 410 males presented with other/not stated cases. Fractures presented with the next greatest category with approximate equal distribution in males (n=163) and females (n=184), with the other diagnoses presenting insignificant results. As seen in all diagnosis categories, females presented with a higher number of cases in comparison to their male counterparts.

The ankle presented as the body part with the majority number of incidents with 39,261 cases being presented. This was followed by injury to the knee with 37,823 injuries and an equal distribution of incidents in both the foot and lower leg with an approximate mean of 19,469 injuries. Upper leg (n=13,172) and toe (n=2,328) injuries were reported to be the most uncommon of lower-extremity TAF injuries. As discussed in Figure 4, trends were displayed between body part and diagnosis association with 781 strain/sprain cases being found in the ankle region and 462 strain/sprain cases found in the knee. Following previous trends, there was an equal distribution of other/not stated reports amongst all body part codes with other reported body part diagnosis' to be variable.

DISCUSSION

As seen through the outputs provided by the NEISS database, the presented 128,761 TAF-related lower-extremity injuries provide evidence of the commonality of these incidents within emergency departments (EDs) from 2014 to 2023. This estimate reflects the average of 12,876 cases which are annually reported. As discussed by Johns Hopkins Medicine, it has been estimated that more than 3.5 million sports injuries have been reported each year, which provides context to prevalence of TAF injuries.[12] This data suggests that approximately 1 in every 272 sports injuries in the United States are associated with track and field. Given its pervasiveness, there is great value in expanding on how early risk prevention and mitigation of injury effects may lead to more effective treatments of TAF ED incidents.

Track and field has long been considered one of the oldest and most popular sports worldwide.

Provided by data from the Statistica Research Department, in 2018/2019, there were 605,354 male participants in comparison to 488, 267 female participants.[13] No resolving research has been currently published which provides insight into racial demographics of TAF athletes. Running, as a general sport, has provided more age diversity, as a

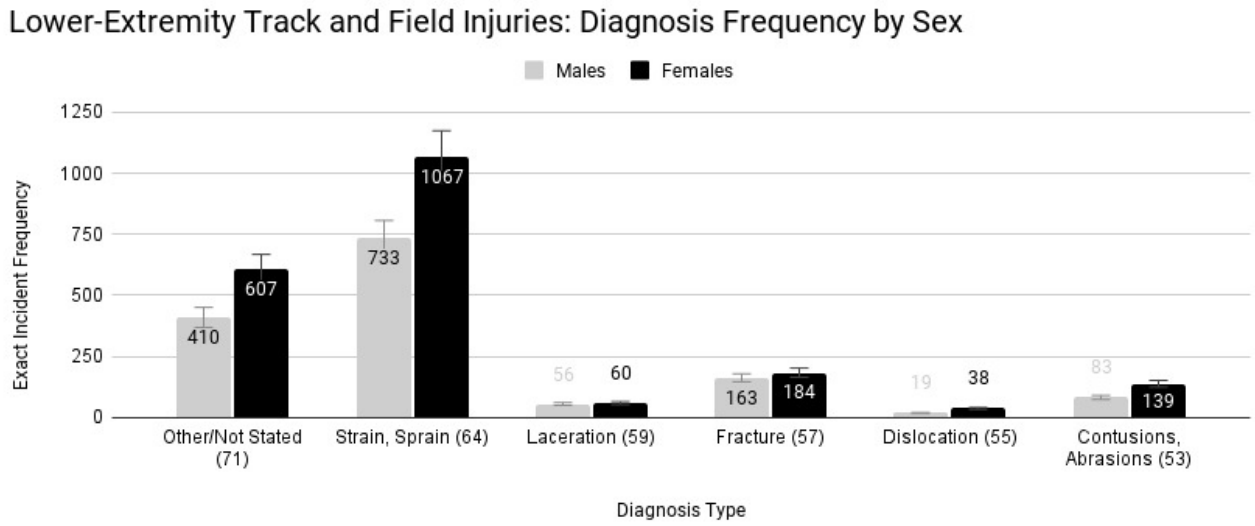

Figure 3. Diagnosis frequency by sex displayed in lower-region TAF injuries from the NEISS database

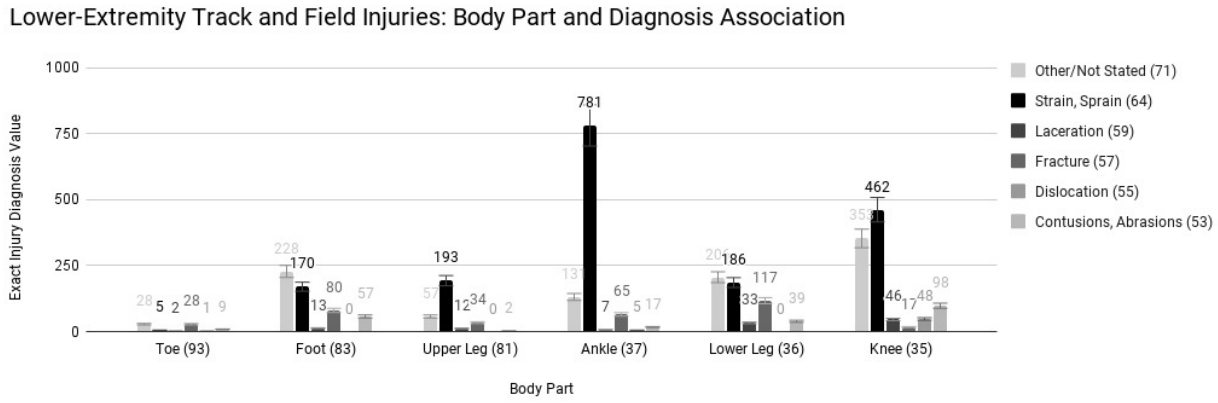

Figure 4. Body part and diagnosis association in lower-extremity TAF injuries from the NEISS database.

present study displayed the average age of runners to be 40.7 years old with the youngest being 18 years old and the oldest being 78 years old.[8] Though, participation in track and field as a sport has clustered more adolescent and early adult athletes. With most sports physiology research being represented in adolescent TAF athletes, youth participation in the sport has been significant through competitive events and ED visits. In lieu of our data, adolescents participate in TAF more than any other high-school sports, with 1,024,959 participants.[9] This, in terms, has led to an increasing trend of adolescent TAF injuries, displayed by higher percentages of ED visits over a 20-year period.[9] Due to certain disproportionalities in terms of age and gender diversity, definitive factors must be taken into account to consider injury prevalence amongst certain demographics.

Seen through the timeline of various reported injuries, the COVID-19 pandemic may have additionally played a potential role in decreasing the amount of diagnosed and represented TAF injuries. Due to the decrease of physical activity and sporting culture displayed during the time period, research reports how ED visits in the US decreased after the beginning of COVID-19 pandemic in 2020, especially during the lockdown period.[10] During the times following, although sports-related injuries have continually displayed seasonal variations, the pattern during COVID-19 may have potentially caused a decrease in generally reported sports injuries.

Analysis from this study has provided that the sex distribution of incidents may be indicative on how diagnosis trends have been represented. As seen, the majority of TAF injuries in lower-extremities have been clustered amongst females, again represented with the number of sprain/strain diagnosis reported. Since females have had representation with more injuries in the various categories of diagnosis', there is data to suggest that females are more susceptible to injury since the sport has continually displayed more male participation. Further research has been concurrent with this suggestion, as an epidemiological study displayed that female TAF athletes experienced an 18% higher risk of injury in comparison to men.[11]

Due to the fortitude of the sport, most track and field athletes have had injuries relating to strains/sprains

(21,095; 49.1%).[14] With focus on running-related musculoskeletal injuries (RRMIs), the knee and ankle regions have been found to have the greatest proportion of injuries, with most relating to variations of pain and stress syndromes.[15] With most lower extremity injuries being related to mechanisms of body stressing, overuse has been a common variable which these athletes struggle with. Due to strenuous exercise routines, the duration and intensity of different training programs continues to have a great effect on the severity and longitude of both the injury and the healing sequence. Although injuries have seen to vary amongst disciplines, 64% of RRMIs have been clustered within lower-limb and foot regions which has led to a 'persistent reduction' in sports performance (claimed by approximately 20% of athletes) up to a 100% observed reduction in sprinters (from foot ligament injuries).[2] Strengthened by results in this study, focus on preventative methods to reduce strains/sprains in TAF athletes is a necessity with prevalence of RRMIs.

Although the majority of injuries within TAF have been displayed as more non-threatening (less hospitalization, more on-site treatment and release), data from this study has displayed prevalence of ankle and knee region incidents in comparison to all other lower-extremity sites. Popular with most track events, running speed, cardiorespiratory endurance, dorsiflexion strength and other factors have been associated with an increased risk of ankle inversion sprains, which lead to patients experiencing persistent ankle pain years following the initial injury.[16] Although reduced at an elite level, high-school athletes (adolescents) have displayed a high amount of knee sprain or strain, as the most common type of season ending injury (13% in male, 22% in female).[17] As injuries in these sites are often due to stressors from training and are event specific, there are preventative methods that can be in place to avoid these incidents. Accounting for 25% of knee injuries in athletes, inadequate preparation, excessive exercise load, and improper training arrangements are amongst some of the greatest stressors causing knee joint injuries.[18]

To avoid this, proper education should be set in place to make sure athletes are available to protect themselves along with coach oversight into the health and physical wellness of athletes. Additionally, development of injury risk reduction strategies can help athletes in the form of proper nutrition, identifying intrinsic and extrinsic risk factors, and utilizing e-Health in sports medicine to estimate case-by-case injury risk per athlete (high perceived level of interest with athletes, coaches, and health professionals).[19] Nutrition solutions, through providing protein and high energy, would be another effective strategy to reduce the risk of injury and decrease recovery time, such as gelatin supplementation which can improve cartilage thickness and decrease knee pain.[20] For ankle sprain/strains, comprehensive assessment and individualized treatments plans should aid in reducing the frequency of recurrent sprains, by utilizing methods like prophylactic exercise and taping/bracing along with proper footwear.[21]

This study, although comprehensive, does provide lamentable limitations which should be noted. The NEISS database only provides data for those who visited the ED for their injuries, which could overlook patients who did not seek care for their incidents. Additionally, due to the greater female cases reported, there could be consideration into varying results if provided with a greater male incident group. Additionally, code 71 (Other/Not Stated), populated with a high aggregation of the data, which limited the depth of the study as it may have overlooked potential diagnoses and body parts which were not specific. For the future, the database should look to provide more diversity in its given diagnostic codes. Potentially valuable geographic and racial informatics were also overlooked in this study, due to inadequate information on the backgrounds and location of many of the patient's injuries using the NEISS database. Information on injury severity was also not provided in the data, and therefore, could not be analyzed in this study. For the future, databases should take into account variable geographics, different racial backgrounds, and injury severity to bring light into how location, stress, and ethnic backgrounds may increase susceptibility or set risks.

CONCLUSION

With a focus on patient rehabilitation, injury analysis, and stressor identification, this study's objectives were to analyze the commonality of lower-extremity TAF injuries within ED patients. Utilizing the NEISS database to survey current trends, focus was brought to the effects of COVID-19 on injury reports, gender trends and age associated with incidents, and the creation of treatment plans that can help patient rehabilitation in area specific injuries. As a widely popular sport, future studies should look at providing a more comprehensive characterization into how a patient's specific demographics may play into injury detection and prevention. This may aid in creating literature that is evocative of the patient story while displaying how individualized treatment plans may lead to a decrease of TAF injuries within susceptible populations.

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