From Head to Toe: Investigating Post-Concussion Risks for Lower Extremity Injuries in Young Athletes

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INTRODUCTION: Between 1.7 and 3 million sports-related concussions occur every year and pose a significant concern for sports medicine physicians given their profound impact on athletes' health. Standard post-concussion protocols typically prescribe a 24-hour cessation of all athletic activities, followed by cautious resumption of light aerobic exercises and gradually increasing to competition in no earlier than one week, provided the athlete is symptom-free. While an estimated 90% of concussion-induced symptoms are transient and resolve within two weeks, the absence of a biomarker-based test makes tracking recovery progression challenging. Existing return-to-play guidelines primarily focus on cognitive and executive functions, often overlooking the assessment of proprioceptive abilities. This omission may place athletes at an increased risk of subsequent lower extremity injuries during competition. This study seeks to assess the rate of lower extremity injuries in athletes in the year following their first concussion, aiming to determine if current guidelines warrant revision to better safeguard against future injuries.

METHODS: This retrospective cohort study utilized a patient record database compiled by PearlDiver Database (PearlDiver, Colorado Springs, CO, USA) which provides access to de-identified information from 151 million patients spanning 2007 to 2020. The International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes for sports physicals and activity in American tackle football, ice hockey, rugby, lacrosse and field hockey, soccer, and basketball were used to create a population of athletes. Then, ICD-10 codes for concussions were used to create a second population of patients who experienced a concussion. All patients had to be active in the PearlDiver system for at least one year prior to and following their specified diagnosis to be eligible for this study. From the athlete population, we identified a group of patients who suffered a concussion within one year of having a sports physical ICD-10 code or other sports-related diagnosis. A control population was created to include athletes who had no history of a concussion for a minimum of one year before and after the study commenced. Finally, both populations were filtered by age to focus on patients below the age of 30. ICD-10 codes for acute lower extremity injuries, such as joint sprains, joint dislocations, muscle strains, ankle fractures, and meniscal tears were used to identify specific injuries within the concussed and non-concussed populations. Tendonopathies, fractures related to trauma, and ambiguous codes were excluded.

RESULTS: There were a total of 899,269 athletes that met the inclusion criteria with a median age of 15. Of the athletes, 58,569 (6.5%) suffered a concussion during the timeframe of the study. A total of 6,051 (10.3%) concussed athletes endured some sort of acute lower extremity injury within 1 year of their first concussion. The most common injuries among concussed athletes were ankle sprain (n = 3168), knee sprain (n = 1761), unspecified ankle injury (n = 1247), meniscal injury (n = 923), and unspecified foot injury (n = 751). These were also top 5 most common common injuries among non-concussed athletes. When compared to the non-concussed athlete population, there was a significant increase in the risk of suffering an unspecified ankle injury (relative risk = 1.40, 95% CI = 1.32 – 1.48), unspecified knee sprain (1.36, 1.27 – 1.46), unspecified foot injury (1.23, 1.14 – 1.32), MCL sprain (1.23, 1.11 – 1.38), ankle sprain (1.18, 1.14 – 1.22), and foot sprain (1.10, 1.01 – 1.21). There was no significant difference in the risk of LCL sprains (1.07, 0.87 – 1.33), medial malleolus fractures (0.95, 0.73 – 1.23), and lower extremity muscle strain (1.07, 0.98 – 1.17). The injury rate per 1000 athletes also tended to be lower for the concussed athletes in the first 3 months after their first concussion but was then increased during the 6-12 month timeframe. Risk factors within the concussed cohort also consisted of female gender (OR = 1.14, 95% CI = 1.08 - 21), tobacco use (1.33, 1.21 – 1.46), and obesity (1.25, 1.16 – 1.35).

DISCUSSION: Our study found a significant increase in the likelihood of suffering several types of lower extremity injuries following a concussion. Specifically, athletes who had experienced a concussion displayed an increased risk of suffering an unspecified ankle injury, unspecified knee sprain, unspecified foot injury, MCL sprain, ankle sprain, and foot sprain within 1 year compared to their non-concussed athlete counterparts. The cause for this increase is likely multifactorial, but we hypothesize delayed improvements in proprioceptive abilities caused by the concussion places athletes at a higher risk for non-contact injuries. This may be due to the fact that the return-to-play timeframe is guided largely by ImPACT testing scores, which assesses memory, attention span, visual and verbal problem solving, reaction time, and processing speed but does not assess proprioception or gait abilities. This study has multiple limitations. The first and most important is that with a database study, although we increased our sample size to the largest cohort of concussed athletes yet, insights from the data are limited by ICD code classifications. Additionally, with a database study, the data is de-identified and patient chart information is not available, which made it difficult to control for potential confounding variables, such as initial injury severity, concomitant cervical spine trauma, training schedule, playing surfaces, medical care, and return-to-play protocol. Furthermore, depending on the timing of the injury, players may opt to extend their recovery, sit out for the remainder of the season, or stop playing the sport, which would underestimate the perceived correlation between a concussion and subsequent lower extremity injury.

SIGNIFICANCE: With the increased risk of injury in the year following a concussion, sports medicine physicians and athletic training staff should more closely monitor post-concussion athletes for lower extremity injuries. Preventative strategies, such as bracing or physical therapy regimens focused on joint stability, could be incorporated to protect athletes from sustaining another injury, and additional studies into refining post-concussion rehabilitation and proprioceptive evaluation would be helpful in shedding light on the best course of action to protect athlete health.
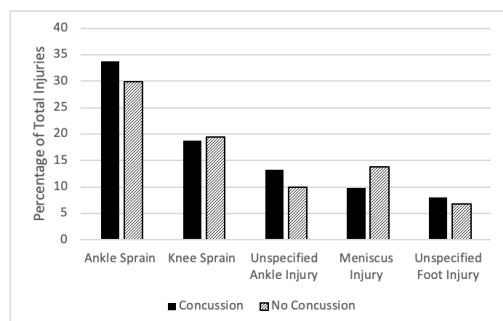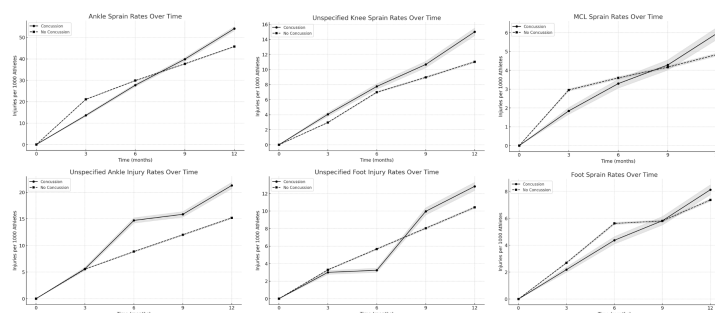
IMAGES AND TABLES:

Figure 1. Most common injuries at 1 year

Figure 2. Injury rates per 1000 athletes at 3, 6, 9, and 12 months