Narrative Review Article

A Narrative Review of Artificial Turf Vs. Natural Grass: The Safety of American Football Playing Fields

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ABSTRACT

This narrative review examines previously published literature investigating the association between playing surface type and lower extremity injury rates in American football across high school, collegiate, and professional levels. Injury rates reported in prior studies were descriptively compared after standardization to injuries per 1,000 athlete exposures (AEs). No new primary data were collected for this review. The results of the previously published literature indicate that the injury rates differ depending on the level of play. In high school and collegiate levels, differences in injury rates between turf and grass surfaces are inconsistent, while at the professional level, numerous studies indicate that injury rates to the lower extremities are higher in synthetic turf surfaces compared to natural grass surfaces.

Keywords: lower extremity injuries; ligament; injury rate; natural grass; artificial turf; football

INTRODUCTION

Player safety is a primary concern in American football at every level: high school, college, and professional. Herein, this paper will simply refer to "American football" as "football." Since the sport is very physical, the risk of serious injuries is elevated compared to other sports. High school athletes are still developing, making them more vulnerable to long-term injuries, while college and professional players face more intense competition at a higher level, leading to a higher frequency and severity of injuries. Injuries sustained during football can affect the entire body, including both upper and lower extremities, as well as the spine and head. In general, lower-body injuries are the most common, accounting for approximately 50% of all injuries (1).

Common injuries include anterior cruciate ligament (ACL) tears, sprains, and muscle strains, which can generally be grouped into ligament/joint injuries and muscular injuries. ACL and medial collateral ligament (MCL) tears are among the most common ligament/joint injuries, often occurring from sudden stops or directional changes, usually without contact (2-3). Muscle injuries typically occur due to overuse or insufficient warm-up/stretching before activity. Most football injuries stem from high-impact collisions, slips, and turf-related issues, underscoring the importance of prevention and awareness in protecting athletes at all levels.

To investigate possible ways to mitigate lower extremity injuries, this review focuses on whether artificial turf or natural grass is safer for players and how playing surfaces influence injury rates in football (4-8). Two primary types of playing fields are used across all levels: artificial turf and natural grass. Synthetic turf is often chosen for its durability, lower maintenance costs,

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Accepted May 27, 2026
https://doi.org/10.70251/HYJR2348.43299303

and ability to withstand heavy use and inclement weather without becoming muddy or patchy. Natural grass, on the other hand, provides better cushioning and is generally preferred for its softer feel. At the professional level, the NFL has a mix of turf and grass stadiums, with 15 using turf and 15 using natural grass (9). Many players advocate for natural grass due to a perceived reduced risk of certain injuries. More recent research supports that natural grass can improve player safety with minimal performance loss (10).

Therefore, the objective of this narrative review is to descriptively compare previously published lower extremity injury rates on artificial turf versus natural grass across high school, collegiate, and professional football. This review does not attempt to establish causation but aims to summarize and synthesize existing findings to inform discussions about player safety.

This narrative review synthesizes key findings from previously published studies on playing surfaces and football injuries. To gather relevant literature, a systematic search of PubMed, Google Scholar, and Sportdiscus was conducted using keywords such as "artificial turf," "natural grass," "football injuries," "lower extremity injuries," and "AEs." The search included studies published from 2000 to 2024 to ensure relevance to modern turf technology. Studies were included if they reported lower extremity injury rates in American football at the high school, collegiate, or professional level and used AEs to standardize injury rates. Exclusion criteria included studies involving sports other than American football, non-lower extremity injuries, or incompatible injury reporting metrics. Once eligible studies were identified, injury data were extracted and standardized to injuries per 1,000 athlete exposures (AEs) to allow fair comparison across different levels of play. When multiple studies were available for a given level, the reported injury rates were descriptively compared rather than pooled or statistically analyzed. No new primary data were collected, and no formal quality assessment was conducted, consistent with the narrative review methodology.

SURFACE-RELATED INJURY RISK ACROSS LEVELS OF FOOTBALL

High School Football

At the high school level, the sport of football is considered to be one of the most played sports in the United States. The field conditions differ depending on the school's budget and geographical location. According to recent reports, an estimated 40% of high schools use turf, while 60% use natural grass fields (11). The quality of maintaining the fields also differs from school to school.

Published studies examining high school football have reported mixed findings regarding surface-related injury risk.mixed findings regarding turf-related injury risk. Some investigations report slightly lower lower-extremity injury rates on artificial turf compared to natural grass (15), while others demonstrate minimal differences. Variability in maintenance quality and exposure measurement may contribute to inconsistent findings. Overall, the literature does not demonstrate a clear consensus at the high school level regarding which surface is consistently associated with higher injury incidence. Representative findings in the literature report injury rates of approximately 13 injuries per 1,000 AEs on turf compared to 16 per 1,000 AEs on natural grass (15-17).

College Football

At the collegiate level, injury surveillance is more standardized compared to high school athletics. Published studies show that injury rates on natural grass may be higher than on artificial turf in some cases, though findings are inconsistent (18). Several factors contribute to this variability, including differences in field maintenance quality, athlete conditioning, and playing style across programs.

College teams often play on a wider variety of fields with varying upkeep, which may influence injury risk on natural grass. Turf fields provide a more consistent surface, potentially reducing factors such as uneven footing and surface degradation. While turf is not risk-free, these findings suggest that natural grass may pose slightly greater hazards than synthetic alternatives in collegiate football. Reported injury rates in collegiate football are approximately 103 injuries per 1,000 AEs on turf and 116 injuries per 1,000 AEs on natural grass, although these values represent descriptive comparisons across multiple studies rather than pooled statistical findings (18).

NFL

Professional football is the highest level of the sport. In this league, players have access to the most advanced resources and support systems available. Several published studies examined injury incidence across playing surfaces (5, 17, 18). Unlike findings on lower levels of play, many NFL-based analyses report higher rates of lower extremity injuries on artificial turf

compared to natural grass when normalized to AEs.

Field conditions are kept pristine, with stadiums using either professional-grade turf or natural grass maintained by ground crews. The NFL data provides a more controlled comparison than high school or collegiate settings. However, even at this level, the findings reflect associations reported in surveillance data rather than definitive causal relationships. At the professional level, reported injury rates are approximately 12 injuries per 1,000 AEs on artificial turf compared to 8 injuries per 1,000 AEs on natural grass (5, 17-18) (Figure 1).

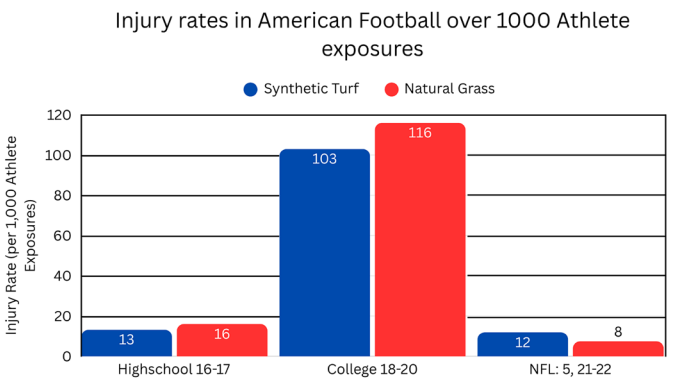

Figure 1. *Reported lower extremity injury rate per 1,000 athlete exposures (AEs) on artificial turf and natural grass across high school, collegiate, and professional football levels. Values are obtained from previously published studies cited in references (5, 14-16). The data represent descriptive comparisons and were not statistically pooled.*

SYNTHESIS AND LIMITATIONS

Several themes emerge when comparing studies across levels of play. The reviewed literature suggests that the relationship between playing surface and injury risk is complex and depends on the level of play. For the high school level, the results suggest that natural grass has a slightly higher injury rate compared to turf, but the results need to be interpreted with caution. It is also important to consider the quality of the grass at the high school level, as some high schools with limited budgets may not have the means to properly maintain their grass playing surfaces. An uneven, muddy, and poorly drained grass surface could increase the risk of slipping, falling, and lower extremity injuries. Turf, on the other hand, offers a uniform playing surface, which could have contributed to the lower injury rates in the high school data.

The reviewed studies at the collegiate level report a higher injury rate on natural grass (116 injuries per 1,000 AEs) than on synthetic turf (103 injuries per 1,000 AEs). This finding suggests that, unlike in the NFL, where some studies report higher injury rates on turf, college injury rates appear slightly lower on artificial surfaces in the data reviewed. Several factors could contribute to this trend, such as differences in field maintenance, playing style, and athlete conditioning. College teams often play in a wider variety of fields with varying upkeep, which may influence injury risk on natural grass. Additionally, turf fields provide a more consistent surface, which may reduce factors such as uneven footing that can occur on poorly maintained grass fields. While these results do not suggest that turf is risk-free, they highlight that at the college level, natural grass may pose greater hazards than synthetic alternatives.

The professional level provides the clearest insight into the turf vs grass debate. Here, turf consistently shows a higher rate of lower extremity injuries than the rate on natural grass. This supports the concerns raised by many athletes, who argue that turf is associated with higher reported injury rates. At the NFL level, both turf and grass fields are maintained to the highest standards, so poor field quality is not a factor in the data. As a result, the difference in reported injury rates may more directly reflect associations between surface characteristics and injury occurrence; however, causation cannot be established from the reviewed data.

In addition to the surface, several other variables that may have acted as confounding variables for the results have been identified. These variables include the type of footwear, the weather, and the position of the player. For instance, the type of cleat used may affect the surface, with some cleats offering better grip on turf than others. Similarly, the weather may also have an effect on the surface, as rain or extreme temperatures may have an effect on the performance of the player. In addition, the risk of injury may vary depending on the type of exposure, such as games or practice, and the player's position. Other factors that may have an effect on the injury rates include the type of turf, the generation of the turf, and the age of the surface. However, the reviewed literature indicates that the relationship between playing surface and lower-extremity injury risk varies across levels of football participation.

This review also has several limitations that should be considered when interpreting the findings. First, injury reporting methods differ across levels of play, and high school, collegiate, and professional leagues

may use different surveillance systems and definitions for reporting injuries. These differences may affect the comparability of reported injury rates. Second, this study relies on previously published research rather than primary data collection, meaning the accuracy of the findings depends on the quality and reporting practices of the original studies. Finally, a formal quality assessment of the included studies was not conducted because this work was designed as a narrative review with descriptive comparison rather than a systematic review or meta-analysis. As a result, variation in study design, data collection methods, and sample sizes across sources may influence the overall conclusions.

It is also essential to recognize the non-safety reasons why turf is so widely used. Artificial surfaces are popular because they are less costly to maintain and usable in a wide range of climate conditions. However, when weighed against the potential for increased injury risk—especially lower extremity injuries that can affect athletic careers– the convenience and economic benefits of turf may come at the expense of player safety. The trade raises ethical concerns, particularly at the professional level, where athletes' livelihoods require staying healthy.

CONCLUSION

This paper examined the relationship between playing surfaces and the frequency of lower extremity injuries in American football at the high school, college, and professional levels. By analyzing injury data standardized to AEs, the findings suggest that while injury patterns vary at the high school and college levels, synthetic turf is associated with a higher injury rate in the NFL. However, the differences in injury rates across all levels are relatively small, and the results do not fully support the claim that natural grass is always safer. While turf offers advantages in durability and maintenance, the trend toward higher injury rates on turf in professional play highlights the need for continued research before firm conclusions about long-term player safety can be drawn.

This narrative review was limited by the scope of the available published literature, especially at the high school and college levels, where injury tracking is less standardized than in the NFL. Future research should include larger, multi-year datasets that capture injury rates across more programs to improve accuracy. Another literature gap exists in comparing specific artificial and natural grass types and how they may influence injuries differently. It would also be valuable to factor in external elements such as weather conditions, footwear, and field maintenance practices, which can all affect lower extremity injury risk. Expanding the scope to include other sports played on similar surfaces could also help determine whether these findings are unique to football or part of a larger trend in athletics.

ACKNOWLEDGEMENTS

I would like to thank my mentor Quintin, as he helped guide me through the process and supported me while creating my paper. I would also like to thank my family, who helped encourage me to create something true with my passion and create something that has my interests and hobbies. Finally, I would like to thank Nathanial, who has helped me prepare my manuscript.

CONFLICT OF INTEREST

The author declares that there are no conflicts of interest related to this work.

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