

Impact of Turf, Weather, and Schedule on the Number of Injuries in an NFL Football Game

Brendan Beattie, Samantha Erne, Jacob Holroyd, Peter Walsh, Dr. Fadel Megahed

Department of Information Systems and Analytics, Miami University, Oxford OH

Introduction

Football is a very contact-driven sport, and many players are often injured in a single NFL game. In recent years, NFL players have gotten faster, stronger, and more exacting, which has made the sport more dangerous. The present study aims to analyze NFL football injuries from **2019-2021** to identify trends and variables that make injury more likely. Reports from the NFL and existing literature have produced conflicting results about what factors are likely to lead to injury, making it unclear what the real answer is.

Authors	Years	Focus	Findings
Mack et al. (2019)	2012-2016	NFL lower body injuries	More injuries on synthetic turf than grass
Loughran et al. (2019)	2004-2014	NCAA football lower body injuries	No difference in lower body injuries on grass vs turf
Calloway et al. (2019)	2013-2016	MSL soccer injuries	Comparable injury rates on turf vs grass
Orchard (2002)	Not applicable	Sports injuries by environment and weather	Weather and environment can lead to more injuries
<ul style="list-style-type: none"> We believe that previous studies were missing some predictors in their analysis that we believe are very influential Previous studies have mostly been private about the data that they used for their analysis, leading us to question the validity of the data that they based their analysis on Most of these studies were performed quite a few years ago, and artificial turf fields have been changing recently Hybrid fields were introduced to the US in 2018, and the effect of this surface on injury rates is a new topic of study 			

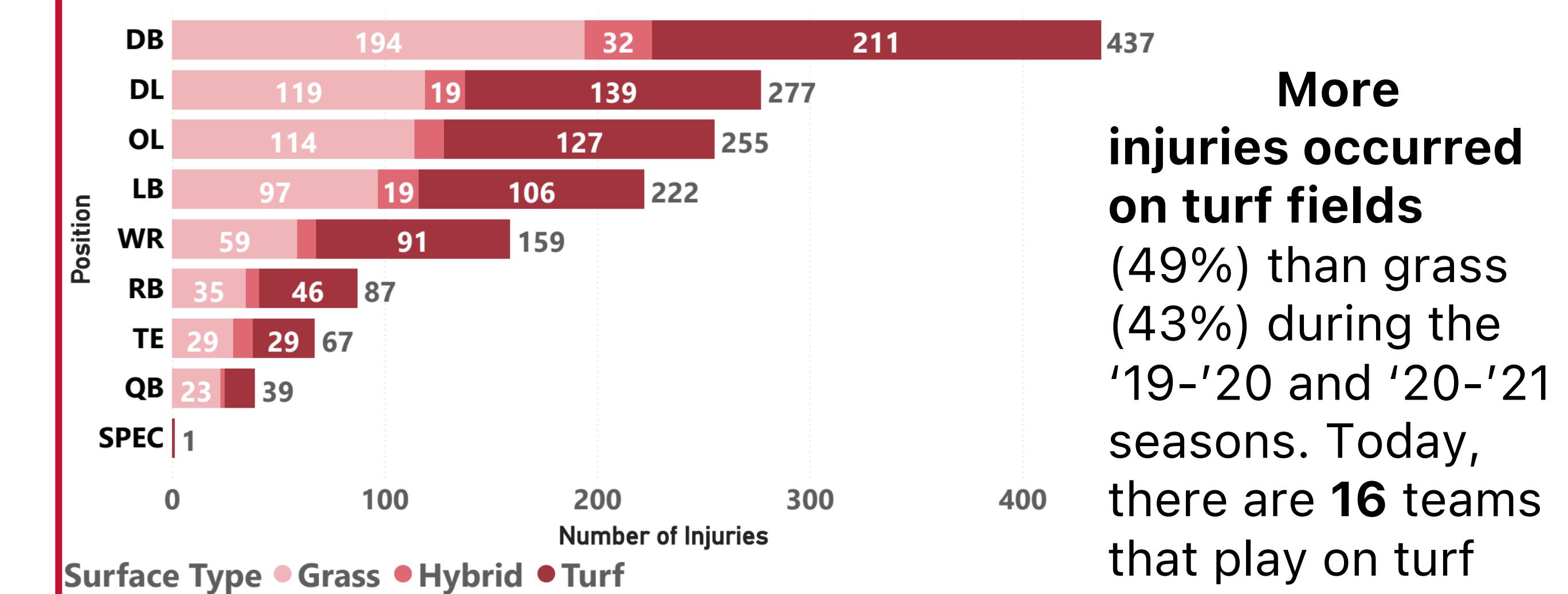
Objectives

- Analyze and collect data from a variety of sources to create a robust model and fill in the gaps of previous research
- Create a Poisson model to predict the number of injuries per game based on a variety of factors (field type, weather, days since last game, etc.)
- Analyze injury rates based on field type (natural grass or synthetic turf), type of injury (contact or non-contact), and player role at time of injury
- Aggregate results by season and play-by-play

Hypotheses

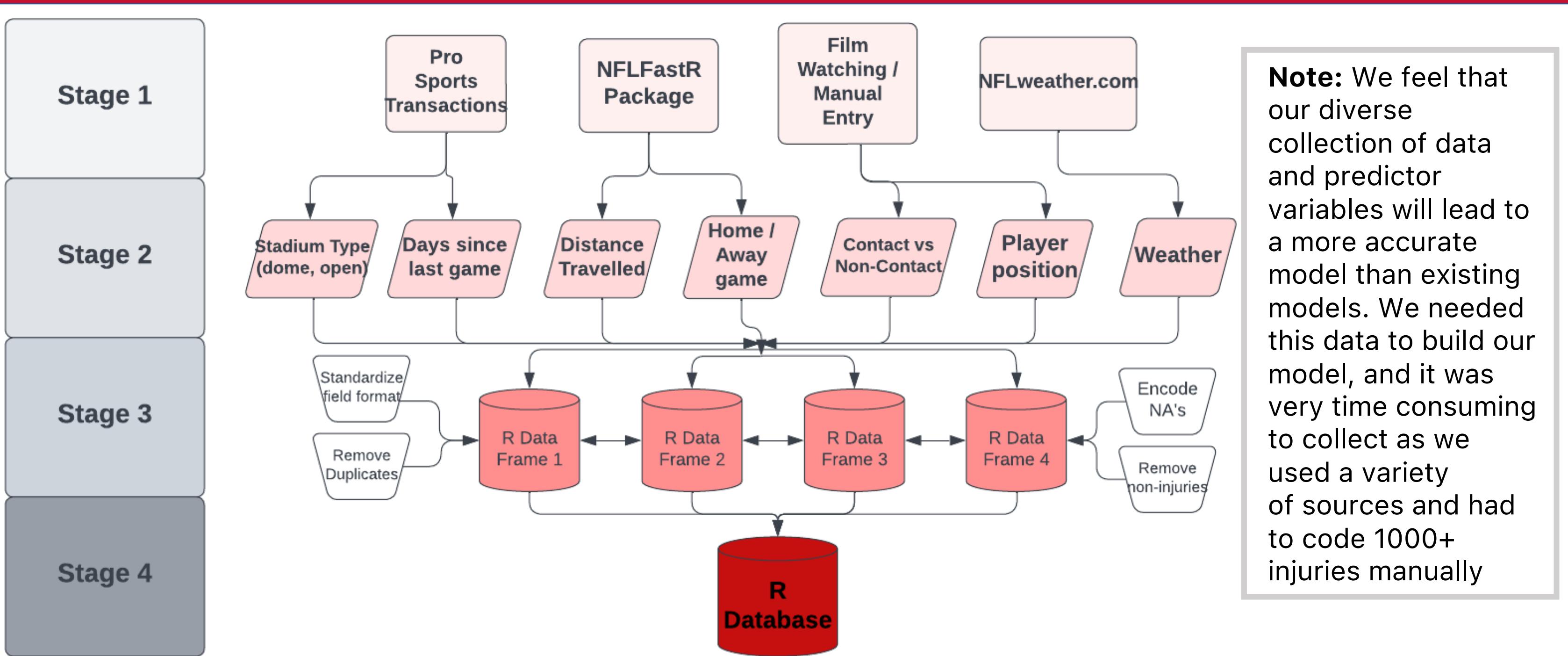
- Players that are playing on natural grass, synthetic turf fields, and hybrid fields will have **different rates of injuries**
- We can better explain injuries by including **additional factors** into models that analyze NFL injuries
- There may be a team effect on injuries due to **poor training or stadium**
- We predict that the following factors will impact injury rates: cold weather ↑, greater distance travelled ↑, home games ↓, dome stadium ↑
- Differences in rates of home and away injuries are caused by changes in factors like distance travelled, type of field (turf/grass), and days since last game

Visualizing the Data



More injuries occurred on turf fields (49%) than grass (43%) during the '19-'20 and '20-'21 seasons. Today, there are **16** teams that play on turf fields, and **16** that play on grass.

Process



Stage 1: We gathered factual and valid data sources to collect our data from

Stage 2: We defined variables of interest and collected them from various sources, using techniques such as web scraping and coding

Stage 3: We compiled our data in R data frames and cleaned the data by standardizing fields, removing doubles, removing unnecessary rows, and more

Stage 4: We aggregated all the data frames into one final database to analyze

Models

We ran many models to find the ones that most accurately predicted injuries in NFL games. For each game, we analyzed injuries in 3 different categories: total injuries, home team injuries, and away team injuries. Our model included weather-related predictors, game-related predictors, schedule-related predictors, type of field, and type of stadium. We used a **Poisson regression model** to fit each potential predictor to the 3 categories. We then selected the top model for each category by assessing different measures of fit and accuracy (such as adjusted r²). Below are the **top models** that we created based on predictive power:

$$\text{Total Injuries} = 1.71 + 0.1795 * \text{Dome} - 0.0014 * \text{Temp} + 0.0537 * \text{Hybrid} - 0.0745 * \text{Turf}$$

$$\text{Home Injuries} = -0.83 + 0.0044 * \text{Humidity} - 0.0033 * \text{Precipitation}$$

$$\text{Away Injuries} = 0.4146 - 0.0044 * \text{Humidity} + 0.0032 * \text{Precipitation} + 0.021 * \text{DaysSinceLastGame}$$

Discussion

Our analysis shows that turf fields led to less total injuries, while **hybrid fields led to more total injuries** in the 2019-2020 & 2020-2021 seasons. Neither of these findings were statistically significant, meaning that the difference in rates was **negligible**, and all field types had similar injury rates. We predicted that turf fields would cause more injuries due to the rigid surface, but we discovered that turf fields have been **improving** in recent years, which may be why **injury rates are similar** among all field types. Other literature looked at seasons from many years ago, when turf fields were newer. The top model for lower body injuries showed similar output to the total injuries model, and field type was not significant.

We also discovered that **dome stadiums** have a significant effect in increasing total injuries that occur in a game. Games played in a dome stadium have 3.2% more injuries than those played in another type of stadium.

Future Goals

In the future, we plan to continue watching film and gathering data on injuries from the 2021-2022 and 2022-2023 seasons to add to our analysis. We understand that this **may change our findings/model** slightly. We also plan to write and submit two research papers to the **American Journal of Sports Medicine**.