Injuries in the NFL

James Shamblin
UC Graduate Student
University of Charleston
2300 MacCorkle Ave SE
Charleston, WV USA 25304
Jamesshamblin@ucwv.edu

Lauren Tate
UC Graduate Student
University of Charleston
2300 MacCorkle Ave SE
Charleston, WV USA 25304
Laurentate@ucwv.edu

ABSTRACT

The National Football League is one of the most successful professional sports leagues in the world. Every single person who has drawn a helmet and shoulder pads dreamed of reaching the NFL at some point in their careers. Although achieving the goal of reaching the league is the reward, the journey to get there and to stay there sustains some of the highest risks. The NFL and football have some of the highest recorded injury rates, so why is that? Do different positions have higher risks over others? Observing data about certain positions, conclusions can be drawn if in fact certain positions are more susceptible to injury.

Keywords
Injury, Concussion, Football, Position

1 INTRODUCTION

The National Football League is a pinnacle of professional sports leagues. Anyone who played football at some point in their lives dreamed of reaching the league. It is a league only the top, peak performing athletes could ever reach, a lot of time an energy must be invested into your training, body, football IQ, and mind in order to reach the league. Like many high paying professions it comes with a lot of risk. There is a reason electricians, wielders, divers, and many more make very good money, it is because they are constantly putting themselves in danger in order to complete work for the greater good. The same can be said for the National Football League, players are putting themselves in high risk and high injury situations to accommodate the entertainment of others. Typically, once a player succumbs to the risk and gets injured, it will severely impact their journey to the league or if they are already there, their place in the league. Injuries are most unfortunate, and some are just a case of wrong place, wrong time.

Data was recorded from the 2012 regular season to the 2015 regular season listing all recorded head injuries, concussions, and illnesses that affected players. The dataset contains key statistics such as who was the injured player, what team did they play for, who were they playing against, how much time each player missed because of the injury, and the type of injury the player sustained. Injuries do not discriminate, especially in the world of football. Everyone is a human between the solid white lines of the field, so everyone is susceptible to damaging their bodies. With that being said, do certain positions have more risk than others in term of injuries? Does the culture of certain teams weigh in on if certain teams have more injuries than others. Some people believe in superstition about their teams always sustaining injuries and ruining their teams chances of a successful season, but believing in curses isn't very scientific. If a team is more successful, would they have less injuries? If a position like a wide receiver or running back involves more risk like moving the ball up and down the field or defending the field would they have more injuries?

2 LITERATURE REVIEW

What positions suffer the most injuries and why?
Football is one of America's favorite hobbies, source of entertainment, pass times, etc. It's played on five separate level's: Little League, Middle School, High School, College, and Professional. Every person who ever suited up in pads and a helmet had the aspiration of playing in the National Football League. The National Football League was founded in 1920 (The Editors of Encyclopedia Britannica, 2019), it is the end goal for all players, but like many high rewarding journey's it is very high risk. Football is a very dangerous, high-contact, and aggressive sport. To achieve greatness, you must be willing to take this punishment and risk in order to reach your full potential. Naturally, you will be putting yourself at risk for injury. There are two very common types of injuries. The first being a knee injury, usually a tear in the anterior or posterior cruciate ligament (ACL/PCL), or the menisci, which is the cartilage in the knee (*Football Injuries - Sports Medicine Program - UR Medicine, University of Rochester Medical Center - Rochester, NY*, n.d.). The second common injury is a concussion, and unfortunately this injury is becoming more common. In the NFL 2020 regular season, there were 126 recorded concussions, and in the 2021

NFL regular season, there were 149, that is an 18 percent increase from the previous year (Seifert, 2023). On top of that, the 2021 season's concussion total is 14 percent about the league average, so we are seeing an increase over the years despite the leagues efforts to reduce them (Seifert, 2023). It's a strange outlier, the fact concussions are increasing despite the league implementing more and more methods to prevent them.

Preventing concussions and other injuries as been the goal for the National Football League for as long as they have been a medical concern, but as mentioned previously they haven't had success. A data sample of 1,192 players were taken, seven percent of those players would miss one game due to concussions and 2.6 percent would miss two or more games (Kneefer, 2023). With concussions being the most common injury among players in the National Football League among players how is the NFL fighting back against this pandemic. In 2006, a study was conducted on current football helmets and the effectiveness of them and what could be done to improve it (Navarro, 2011). The study also mentioned on how to improve protection and helmet designs. More padding, a certain type of padding designed for preventing catastrophic head collisions, obviously on the head, crown of the helmet, face, and neck areas (Navarro, 2011). We can armor football players up likes it's the medieval times, but there is a point of the legitimacy and usability of new helmets. If we were to add enough padding until even the strongest forces of hits couldn't reach the head, the helmets were probably be larger than the players themselves. Although things are starting to look bleak, the NFL has taken a new helmet design into consideration and it was tested this past season. After the 2021 NFL season, new rules and designs were realized in order to combat the rising concussions from the 2021 season. Training camps were requiring extra layers of padding, and new helmets saw a reduction in concussions by 25 percent (*Helmet Innovation: More and Better Choices, Fewer Concussions*, 2022). The NFL plans to continue to move forward with their innovations helmets and protocols, they have contributed to five out of the 6 top safest helmets in football already (*Helmet Innovation: More and Better Choices, Fewer Concussions*, 2022). The NFL and all of football will continue to work vigorously to prove their 2021 regular season was simply an outlier in their long and prosperous future.

Football positions are broken up into offense, defense, and special teams. The offense consists of skill positions: quarterbacks, running backs, wide-receivers, and tight ends, and the lineman: guards, tackles, and centers. The defense consists of the lineman: defensive lineman and defensive tackles, and the secondary: cornerbacks, safeties, outside linebackers, and middle linebackers. The special teams consist of a punter, a holder, a long snapper, a kicker, and a return man. Each one of these positions play a very important role and must perform a certain task in order to achieve team success. Having different positions doing different things would almost correlate with injuries. A kicker safely kicking off a tee and a running back charging into the teeth of the defense will obviously have different injuries, injury rates, and the severity of the injury. A study was done for the 2020 NFL regular season. It divides up the positions in defensive lineman, defensive skill, offensive lineman, and offensive skill. The category of injuries is divided up into tweak, minor injury, major injury, season ending, and career ending (Calhoun, 2022). This test revolves around knee injuries, another common injury type when covering injuries in the National Football League. Defensive skill had the most recorded injuries with 98, and offensive lineman had the lowest with 63 (Calhoun, 2022). Offensive lineman have a very difficult role, but its deemed one of the safest because they, for the most part, stay in one place and focus on blocking all incoming defenders. They are essentially a brick wall and absorb all incoming fire, ironically since they focus on tanking the power of the defense they have the lowest injury count. Defensive skill have the most major injuries, the other outlier is both skills have the most career ending injuries with a combined 9 compared to the lineman with a combined 2 (Calhoun, 2022).

3 THEORY LITERATURE REVIEW
Do certain teams suffer more injuries and why?
Hypothesis – certain teams experience more injuries than others.
Null Hypothesis – certain teams do not experience more injuries than others.
Factors that contribute to injuries within football

Injuries occur within all sports, however, football is considered a contact sport and thus leads to the belief that there are significant amount of injuries that occur, additionally what causes these injuries can also be considered, as there are numerous variables within the sport of football that could contribute to the prevalence of injuries, these may be external or internal factors; this can further lead to the hypothesis that some teams may be more at risk of players becoming injured than others. A study by Lawrence, Comper, and Hutchison (2016) looked in depth at how the external environment can impact the prevalence of injuries within football. They looked an numerous predictor variables, including game altitude, the surface being played on, what week the game was in season, time zone changes, distance teams had to travel to games, temperature, outcome of the game, the importance of the game, and the time between games and then compared these variables with the five most prevalent injuries within the sport, shoulder injuries, concussion, knee injuries, hamstring injuries, and ankle injuries. What was found was that there was a significant increase of risk of concussion and ankle injuries when games were played at a lower temperature; the mechanisms behind this were speculated to potentially be due to the lack of elasticity in protective equipment during impact for concussions, and for ankle injuries it was suggested that intrinsic factors are more likely to be the cause than external influences. Lawrence, Comper, and Hutichson also found a significant increase in shoulder injuries when games were

played on grass as opposed to turf, which they state could be due to turf fields being more shock absorbent. However, there was no association between variables of distance travelled, game outcome, time zone changes, game week, game altitude, game importance, and time between games and the occurrence of injuries.

A study that supports this data is by Angileri et al. (2023) as they looked at distance travelled and its influence on the occurrence of injuries. They used data from 32 teams across 5 NFL seasons and included the variables of distance travelled from the home stadium to the away stadium, taking into consideration overseas games, when the bye week occurred, how many games were in the regular season, and playoff games. The findings corroborate what Lawrence, Comper, and Hutchison (2016) found in that there is no association between the distance teams must travel and the occurrence of injuries; however, what was found was that teams who did not make the playoffs had a greater injury rate than those who did qualify.

In summary it can be determined by that data supported within the studies found that some teams may be more at risk of suffering more injuries due to their environment of where they are based; for instance, teams who are based more North within the US may suffer more injuries than those in the South because of the differing environment factors such as temperature which has been observed to play a factor within the occurrence of injuries.

Contributing factors to concussion within football.

Within American Football concussion has become a topic of conversation due the long-term effects it has been seen to have on retired players, and there are many studies that have been looking into these effects. However, are there factors that may cause some teams to have more than others?

A study by Haider et al. (2018) investigated the influence the environment might have on the number of concussions occurring within football. The variables that they concentrated on were temperature, humidity, dew point, and barometric pressure and they compared the data they obtained from 960 NFL regular season games spanning across the 2012 to 2015 season regarding these variables with the incidence and probability of concussion. The findings from their study were that there was a total of 564 concussions out of the 960 games looked at, in which there were 411 games where concussions occurred and 549 games without concussions of which there is a significant difference between the average temperature between the games that concussions occurred in and those that had no concussions. This finding suggested that games where the average temperature was warmer had less concussions than games where the temperature was colder; it was also observed that when games were played at a colder dew point this too caused the incidence of concussion to increase; however, there was no significant difference between humidity and barometric pressure with the frequency of concussion. The conclusions drawn from this study further support the findings from the study from Lawrence, Comper, and Hutchison (2016) previously spoken about. Another study has also looked at the impact of altitude and whether that plays a role in the incidence of concussions, the previous study from Haider et al. (2018) suggested that there was no significant impact of barometric pressure on the occurrence of concussions within football. The study from Lawrence, Comper, and Hutchison also found that altitude did not play a significant role within the prevalence of injuries, however a study from Connolly et al. (2018) suggests that altitude may play a substantial role within reducing the incidence of concussion. Their findings were that teams who were located in higher altitudes had a significant reduction in the incidence of concussions when playing at high altitudes; however, teams from lower altitudes did not see this impact when playing at a higher altitude and vice versa. Despite the effects not being seen when high altitude teams travel to a lower altitude it could still suggest that teams within these high-altitude locations may have an advantage over others when it comes to the incidence of concussions throughout the season and keeping more players on the field because they would reap the benefits when playing other teams from high altitudes.

Other studies (Teramoto et al., 2017; Hannah et al, 2019) have observed whether game importance or schedule plays a role within the prevalence of concussions. The study from Teramoto et al. found that although concussions appeared to be more frequent within the second half of the season there is not significant difference between this and the game schedule; they suggest that the occurrence of these concussions may be more due to the fatigue element or environmental factors such as the temperature due to the timing of the NFL season. In relation to this study Hannah et al. researched whether more concussions occurred within games that appear to have a greater importance, such as games that could determine reaching the playoffs; what was found within this study was that there was no significant difference between the perceived importance of the game and the incidence of concussions, despite for running backs which has been suggested could be due to fatigue levels which supports the suggestion from Teramoto et al. regarding fatigue and prevalence of concussion. The findings from both studies also support those found within the Lawrence, Comper, and Hutchison study from 2016, that looked at a range of factors that may influence injuries which included concussion.

In conclusion, the studies found regarding concussion and factors that may influence the incidence rate it can be suggested that some teams may have an advantage over others dependent on environmental factors, specifically the temperature, and with the potential of altitude also playing a role.

4. METHODS

The data is stored in a csv file, the file contains injuries between the 2012 and 2015 National Football League regular season. The columns with the data needed are Season, Position, Team, and Injury Reported. Using R import functions, the dataset is imported into R studio. From there, exploratory analysis can be conducted along with several key visualizations that will be responsible for visualizing the analytical findings. The visualizations will aim to answer the following questions: Which teams suffer the most injuries? Which positions suffer the most injuries?

5. DATA AND DATA ANALYSIS

The data provided regarding the type of injury per team showed that some teams incur more of one type of injury than others. The bar graph below shows a visualization that Cleveland Browns saw the most injuries over a span of 3 seasons with a total of 22 injuries, however, when looking specifically at injury type, Oakland Raiders saw the most concussions, Cleveland Browns saw the most head injuries, and Seattle Seahawks saw the most illness.
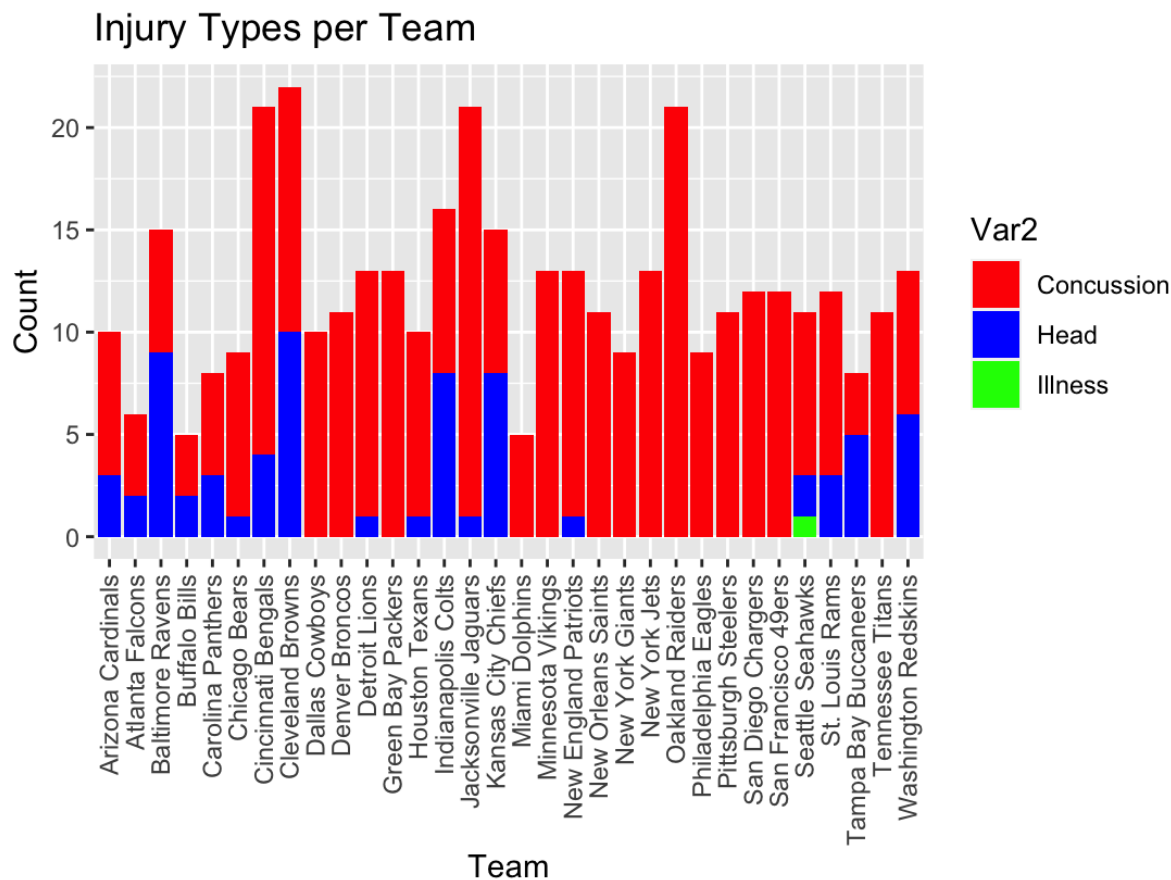

Injury Types per Season

Looking into the type of injuries observed across 3 seasons, the data showed that within the 2013/2014 concussions were at their highest of 148. However, the 2012/2013 season saw the most injuries overall and 2014/2015 seeing the least injuries overall.
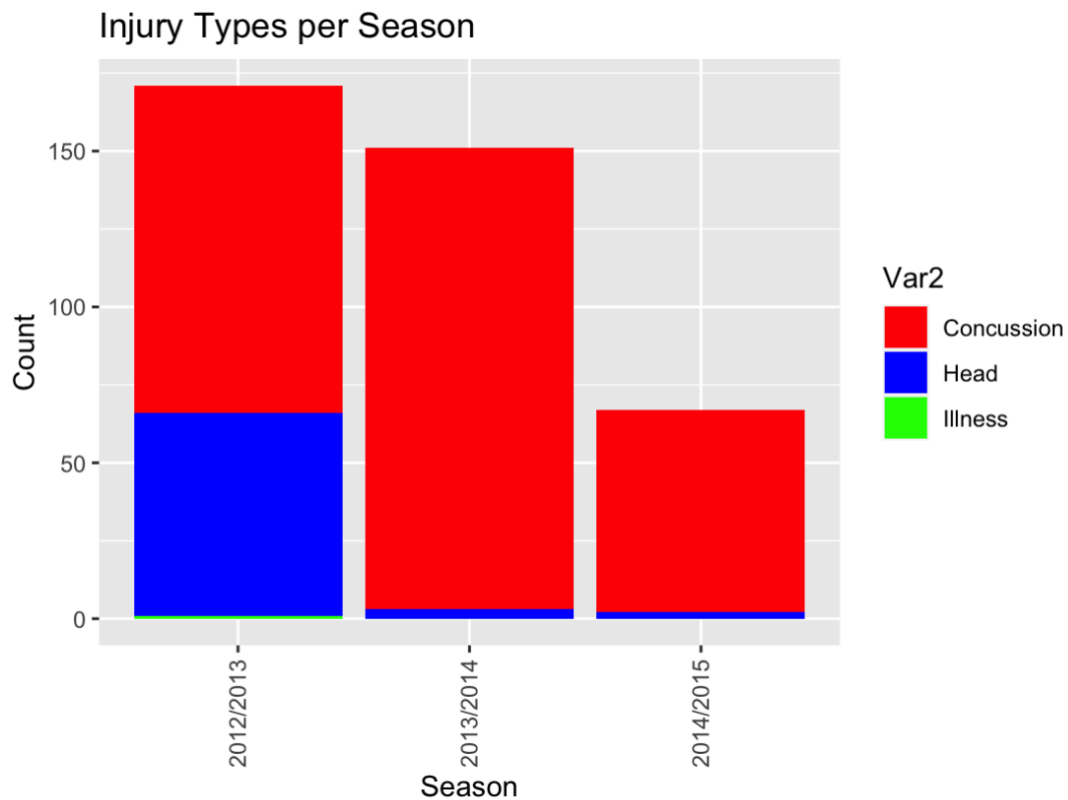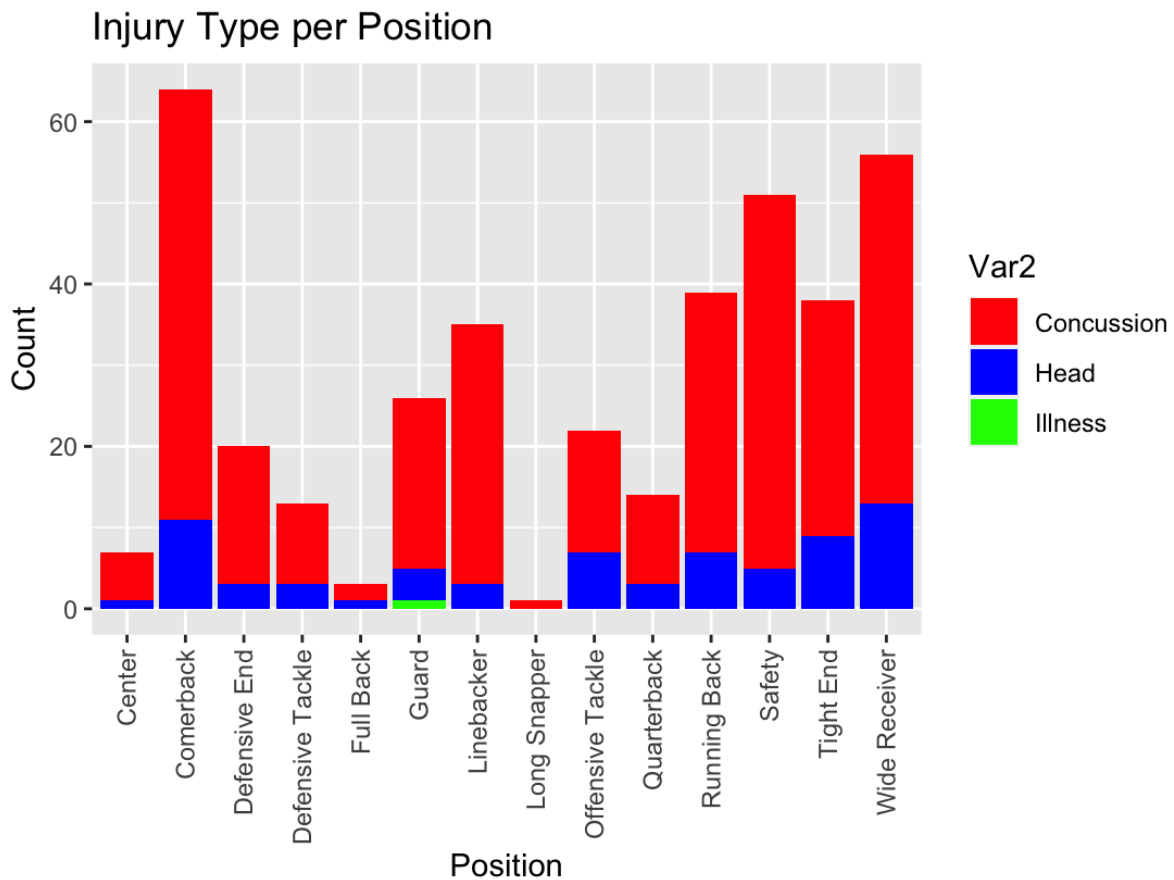
Team Injuries per Season

Data for team injuries per seasons showed that some teams experience more injuries across certain seasons, and some experience more injuries in total. The bar graph below shows that both Cincinnati Bengals and Cleveland Browns have experienced a significant number of injuries across 3 seasons, totaling at 22 each, whereas the Buffalo Bills experienced the least number of injuries with a total of 5. The data also shows that some teams experienced more injuries within certain seasons than others, for example, Oakland Raiders experienced the most injuries in 2012/2013, Cincinnati Bengals in the 2013/2014 season and also the 2014/2015 season.

Team Injuries per Season

Var2
- 2012/2013
- 2013/2014
- 2014/2015
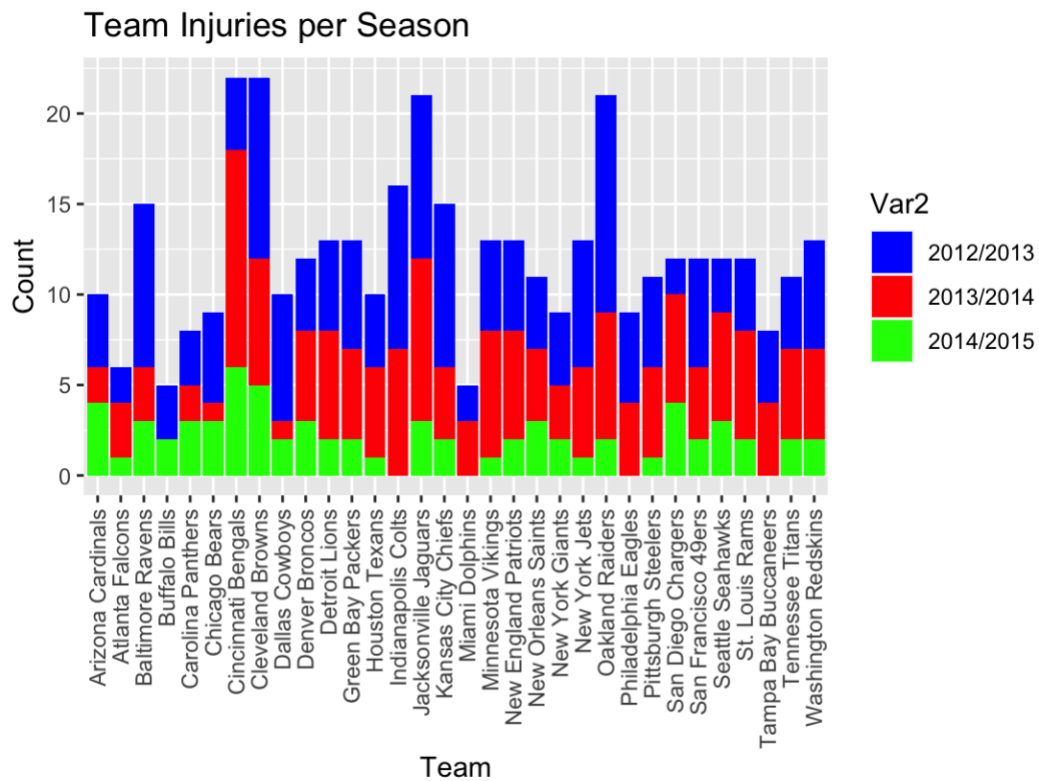
Injury Type per Position

When look more specifically at the position types and the injuries they incur, the data showed that cornerbacks experience significantly more injuries than other positions, it also shows that of those injuries they experience the most concussions, whereas long snappers are observed to get the least number of injuries and concussions. In addition, it shows that Wide Receivers experience more head injuries than other positions, and that guards have more illness than other positions.

Injury Type per Position

Var2
- Concussion (red)
- Head (blue)
- Illness (green)

Positional Injuries per Season

Visualizations displaying the injuries different positions get per season show similar data to the types of injuries each position experiences, however, it shows in which seasons these injuries were most prevalent for these positions. What can be observed is that within the 2012/2013 season cornerbacks experienced the most injuries, with safety's and wide receiver's experiencing the next most. Within the 2013/2014 seasons cornerbacks were still observed to experience the greatest number of injuries, and again safety's were second, however wide receiver's also saw the second most amount of injuries this season too. Finally, within the 2014/2015 season the trend did not change of cornerbacks seeing the most number of injuries and safety's being second to that.

6. IMPLICATIONS

The resulting data could benefit the skill positions greatly. Addressing the fact the skill positions on both the offense and defense side of the football have recorded the most head injuries and concussions. This makes sense since they play the pass and not each other, what that means is when the quarterback throws a pass, the receiver and cornerback/safety are looking up at the ball and trying to make a play. They aren't entirely aware of their surroundings and when you drop your awareness, disaster can strike more easily. With the data collected, rules could be put in place, or extra protection could be handed out to these positions to prevent unaware collisions. Almost like how punters have the rule you can not touch their plant leg or it will be a fifteen yard penalty called "roughing the kicker". By figuring out means and ways to address the receivers and cornerback clashes in a safe manner, the recorded injuries would drop significantly.

7. WEAKNESSES, FUTURE RESEARCH, AKNOWLEDGEMENTS

A major flaw in the given dataset is the length of time and time period itself. The data is almost ten years old, this doesn't challenge the integrity of the data since it is set in stone, but the National Football League has had almost ten years to combat these certain types of injuries. Especially head injuries/concussions, the NFL has invested countless hours and dollars in the art of concussion prevention, if this data was recorded in the past four seasons we would no doubt see a difference. Another setback would be the limitation in criteria of injuries. There are countless injuries that are possible to occur on the gridiron, it's a wonder what can happen to the human body when its succumbs to hundreds of pounds of force in a fraction of a second. Other injuries, besides head injuries, can include tears in the knee, shoulder, ankle sprains, bruised or cracked ribs, wrist mobility problems, and more. No doubt would there be plenty of data for the injuries just mentioned, the given dataset is only a fraction of what the true injury potential.

Future research should revolve around expanding the dataset to include more injury variety. By including more injury variety there would no doubt be a shift in the resulting visualizations. Also, this would add another dimension towards the analysis, increasing injuries will exponentially increase the data, therefore more comparisons and visualizations can be manipulated and created. Expanding on the broadness of Illness would provide more insight on how it affects a players' game. For example, a cold would have lesser, almost unnoticeable affects compared to playing while having COVID-19. Improving the range from only three years to any amount over three would easily improve studies, this dataset is very static, the more data gives it more of a dynamic implication. Especially when the national football league becomes a variable by combating certain types of injuries, it manipulates the data.

8. CONCLUSION

In conclusion, the data that has been analyzed supports the literature that some teams may observe more injuries than others due to external factors, this is demonstrated by the highest total amount of injuries teams have observed across the three seasons of 2012-2015 being from teams where the climate is typically colder, however, this difference may not be significant as there are some teams that also experienced a high number of injuries from locations that are warmer. When looking more in-depth at data regarding concussions, it shows that the hypothesis that some teams suffer more concussions than others may not be valid, as all teams have suffered with concussions thus not supporting the literature that the environment these teams reside in impacts the incidence of concussion. However, regarding both total injury incidence and concussion incidence, the data does not take into consideration where the injury occurred, meaning that there is a chance these injuries happened within an environment that could have an impact on the incidence rate, for example, the injuries may have occurred at a location where the weather was colder.

Furthermore, from the data findings it can be hypothesized that more injuries occur to certain positions because it shows that cornerbacks significantly experience more injuries than other positions, this may be due to the role that they play within football, as they are more likely to make hard tackles. In addition, cornerbacks are also most likely to suffer from concussions which too can be related to the fact they have to make tackles, this data supports the literature that was found as it stated that positions which can be considered as defensive skill positions, such as a cornerback, encounter more injuries than other positions.

9. REFERENCES

Angileri, H. S., McLoughlin, D. E., Owen, M. M., May, J. M., Terry, M. A., & Tjong, V. K. (2023). Association of Injury Rates Among Players in the National Football League With Playoff Qualification, Travel Distance, Game Timing, and the Addition of Another Game: Data From the 2017 to 2022 Seasons. *Orthopaedic journal of sports medicine*, *11*(8),

23259671231177633. https://doi.org/10.1177/23259671231177633

Lawrence, D. W., Comper, P., & Hutchison, M. G. (2016). Influence of Extrinsic Risk Factors on National Football League Injury Rates. *Orthopaedic journal of sports medicine*, *4*(3), 2325967116639222. https://doi.org/10.1177/2325967116639222

Haider, S., Kaye-Kauderer, H. P., Maniya, A. Y., Dai, J. B., Li, A. Y., Post, A. F., Sobotka, S., Adams, R., Gometz, A., Lovell, M. R., & Choudhri, T. F. (2018). Does the Environment Influence the Frequency of Concussion Incidence in Professional Football?. *Cureus*, *10*(11), e3627. https://doi.org/10.7759/cureus.3627

Connolly, J. G., Nathanson, J. T., Sobotka, S., Haider, S., Gometz, A., Lovell, M., & Choudhri, T. (2018). Effect of Playing and Training at Altitude on Concussion Incidence in Professional Football. *Orthopaedic journal of sports medicine*, *6*(12), 2325967118794928. https://doi.org/10.1177/2325967118794928

Teramoto, M., Cushman, D. M., Cross, C. L., Curtiss, H. M., & Willick, S. E. (2017). Game Schedules and Rate of Concussions in the National Football League. *Orthopaedic journal of sports medicine*, *5*(11), 2325967117740862. https://doi.org/10.1177/2325967117740862

Hannah, T., Dreher, N., Shankar, D. S., Li, A. Y., Dai, J., Lovell, M. R., & Choudhri, T. F. (2019). The Effect of Game Importance on Concussion Incidence in the National Football League: An Observational Study. *Cureus*, *11*(11), e6252. https://doi.org/10.7759/cureus.6252

The Editors of Encyclopedia Britannica. (2019). National Football League | History & Teams. In *Encyclopedia Britannica*. Retrieved on September 30th, 2023. https://www.britannica.com/topic/National-Football-League

Football Injuries - Sports Medicine Program - UR Medicine, University of Rochester Medical Center - Rochester, NY. (n.d.). Www.urmc.rochester.edu. Retrieved on September 30th, 2023. https://www.urmc.rochester.edu/orthopaedics/sports-medicine/football-injuries.shtml

Seifert, K. (2023, February 3). *NFL: 149 concussions during '22 season, up 18%*. ESPN.com. Retrieved on September 30th, 2023. https://www.espn.com/nfl/story/_/id/35582897/nfl-says-regular-season-concussions-increased-18-2022

Keefer, Q.A.W., Kniesner, T.J. "Injury risk, concussions, race, and pay in the NFL". Retrieved on October 1st, 2023. *J Risk Uncertain* (2023). https://doi.org/10.1007/s11166-023-09415-1

Navarro, Rodolfo R. MD. Protective Equipment and the Prevention of Concussion - What Is the Evidence?. Current Sports Medicine Reports 10(1):p 27-31, January 2011. Retrieved on October 1st, 2023. | DOI: 10.1249/JSR.0b013e318205e072

Helmet Innovation: More and Better Choices, Fewer Concussions. (2022, September 16). Retrieved on October 1st, 2023. NFL.com. https://www.nfl.com/playerhealthandsafety/equipment-and-innovation/engineering-technology/helmet-innovation-more-and-better-choices-fewer-concussions

Calhoun, K. (2022). What Factors Play The Most Prominent Role In Knee Injury For Professional Football Players In The NFL? A Study Of Injury Risk And Career Longevity For High-Level Athletes. Retrieved on October 2nd, 2023.