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**Examining the Injury Rates of High School and Collegiate Athletes in the United States**

**Is Football the most dangerous sport?**

**Abstract**

There is an ongoing debate with parents and scientific researchers if it is safe for children to play in football. However, the research conducted to determine the safety of football is focused singularly on the context within football without a comparative study across all sports. We decided to conduct a comparative study of the injury rates of 18 popular sports in the United States with explanatory variables of sports, level of competition, and type of injury. We used ANOVA tests to determine that the injury rates of football, gymnastics, and skiing are significantly different than other popular sports. Then, we narrowed down our analysis to focus on injury rates of football, gymnastics, and skiing. Within this group, there is no statistical difference in injury rates, which suggests that while football may have statistically different injury rates compared to all sports, it cannot be concluded to be the most dangerous sport.

**Background and Significance**

Increasingly, parents have been questioning the dangers of football after recent, tragic deaths related to the popular sport. This issue has been highly publicized by parents, former football players, and the NFL. “Would you let your son play football?” is a common question parents have been asking retired players, who been through the effects of playing football (Gregory 2014). In response, schools and football organizations have agreed to limit the amount of full-contact practices per week (Nicholson 2015). Despite the recent traumatic injuries related to football, current research has neglected the acknowledgement of injury rates in other sports, which also have important implications. An example is the injury rates in high school rugby, which has a higher injury rate than football (Pfister et al 2016).

Because of the lack of comparative studies of injury rates across all sports, we decided to conduct our analysis to test if there are any differences in injury rates between sports. Accurate injury statistics for organized sports will motivate changes in safety regulations and guide coaches to look out for their players.

**Methods**

Data Collection:

Current research in injury rates in high school sports have used inappropriate data for their analysis. For many studies, athletic trainers should be the primary data providers because of their higher tendency to report injuries than coaches (Yard 2009). Our data was collected by the National Center for Catastrophic Sport Injury Research (NCCSIR), an organization established at University of North Carolina in 1982. NCCSIR collected data through the assistance of athletic trainers, athletic directors, and professional researchers throughout the United States. We used solely their “direct injury” data from 1982 to 2015. “Direct injury” is defined as injuries that resulted directly from participants engaging in the sport during competition.

Variables:

Our response variable is direct injury rates (per one hundred thousand participants). The explanatory variables are the different sports and competitive level - college or high school - that the sport is played in. Additionally, we looked into the different type of injury categories: “Fatality” defined as death; “Non-Fatality” defined as permanent severe functional disability; “Serious” defined as no permanent functional disability but severe injury.

Analytical Methods:

We ran two-way ANOVAs tests to determine differences, if any, between injury rates of different sports at the high school and college level. We used a wide range of sports in our analysis. However, to better fit our data to be normally distributed, we used gymnastics, football, and skiing in the final ANOVA test.

**Results**

Our ANOVA tests have concluded that there is a significance difference in injury rates between football, gymnastics, and skiing. Furthermore, a follow-up ANOVA test to determine if these sports have any significance difference within this sub-set of sports. There were no significant difference between the sports, however the level of sports showed significance (p=0.014).



 Figure 1. A boxplot of the injury rates in each sport at the level of high school and collegiate. The proportion is used as the response variable, injury rate. Significantly different injury rates were found in football, gymnastics, and skiing.



 Figure 2. Residual plots for the second ANOVA test with the sports: football, gymnastics, and skiing. These residual plots show no pattern, which we can assume that this data set is safe to be used in our analysis.

**Discussion**

The results above show that football, gymnastics, and skiing are the sports that have significantly higher injury rates. Additionally, the competitive level of the sports and injury category have strong influence on injury rates. Among these sports, there are no significant differences in injury rates, but the competitive level these sports are played at are significant (p=0.014). This suggests that football, gymnastics, and skiing have higher injury rates compared to all other sports, but among these sports, they have statistically insignificant differences within this sub-group.

However, our results may be confounded by many uncontrollable variables. For example, our data was only from high schools and colleges that are enrolled in National Athletic Trainers’ Association with an affiliated certified athletic trainer. This would cause our data given to be underrepresented because of other high schools that are not included in our sources’ estimated proportions of injury rates. In turn, it would affect our analysis, which may be a reason why college and high school level sports have significantly different injury rates. Because of the under representation of high school injuries, college injury rates may appear to higher, which may be an inaccurate conclusion. Another weakness in our analysis is our reliance on the assumption to say that each categorical, explanatory variable is independent. More than likely, a high school athlete will play more than one sport. This is a confounding variable that cannot be accounted, which can make our analysis not reliable. Lastly, our distribution of the injury rates was not quite normal. As a result, the test will not be as accurate. These variables all have an effect on our analysis, which should be interpreted with caution.

Our findings have huge ramifications to the future of the safety for high school and college athletes. These findings show that football is not only considerably dangerous in relation to other popular sports, but that gymnastics and skiing are similar as well and the danger involved in participating in these sports is under recognized. Safety regulations and policies need to change according to the type of sport and the level played at in order to decrease the rate of injuries. Further research must be conducted to investigate the injury rates with more complete data from high schools and colleges. It is also important to research more about the differences in safety equipment for each sport. This study can make a lasting impact on the safety of athletes in order to reduce unnecessary injuries and maintain the health of the younger generations.

**References**

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**Appendix**

ANOVA Test: Injury Rates versus level, sports, injury category. This ANOVA summary is for all 18 sports.

Model Summary

 S R-sq R-sq(adj) R-sq(pred)

1.50338 30.44% 18.23% 3.68%

Coefficients

Term Coef SE Coef T-Value P-Value VIF

Constant 0.772 0.147 5.25 0.000

Injury Category

 1 -0.272 0.183 -1.49 0.140 1.33

 2 0.124 0.183 0.68 0.501 1.33

Level

 College 0.474 0.141 3.37 0.001 1.18

Sports

 Baseball -0.327 0.597 -0.55 0.585 1.89

 Basketball -0.377 0.496 -0.76 0.449 1.63

 Cheerleading 0.989 0.611 1.62 0.108 1.98

 Cross Country -0.285 0.842 -0.34 0.736 2.80

 Equestrian 0.287 0.845 0.34 0.734 2.82

 Field Hockey -0.224 0.597 -0.37 0.709 1.89

 Football 1.350 0.597 2.26 0.026 1.89

 Golf -0.291 0.842 -0.35 0.730 2.80

 Gymnastics 1.375 0.435 3.16 0.002 1.48

 Ice Hockey 0.673 0.435 1.55 0.124 1.48

 Lacrosse -0.350 0.435 -0.81 0.422 1.48

 Rowing -0.776 0.845 -0.92 0.360 2.82

 Skiing 0.992 0.498 1.99 0.049 1.64

 Soccer -0.676 0.435 -1.56 0.123 1.48

 Softball -0.687 0.597 -1.15 0.252 1.89

 Swimming -0.527 0.496 -1.06 0.290 1.63

 Track and Field -0.650 0.435 -1.50 0.138 1.48

ANOVA Test: Injury Rates versus level, sports, injury category. This ANOVA summary is for only football, gymnastics, and skiing.

Model Summary

 S R-sq R-sq(adj) R-sq(pred)

2.56812 25.85% 8.74% 0.00%

Coefficients

Term Coef SE Coef T-Value P-Value VIF

Constant 1.973 0.474 4.16 0.000

LEVEL

 College 1.328 0.504 2.64 0.014 1.26

SPORTS

 Football 0.149 0.880 0.17 0.867 1.73

 Gymnastics 0.174 0.707 0.25 0.807 1.57

 Ice Hockey 0.170 0.971 0.18 0.862 2.11

INJURY CATEGORY

 1 -0.598 0.632 -0.95 0.353 1.33

 2 0.353 0.632 0.56 0.581 1.33