

The Connection Between Fastball Velocity and Injuries and How Injuries Impact Team Performance

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Introduction and Objectives

In the MLB, the pitching positions are grueling and prone to injury. While 741 players threw at least 4 innings, more than 150 pitchers were placed on the IL (injured list) for elbow or shoulder related injuries over the season according to MLB data. For players, injuries can derail their careers, and for teams, injuries can derail the success of their season. As such, it is important for MLB teams and players to understand the risk factors and effects of pitching injuries.

Background:

There is existing evidence that maximum pitch velocity correlates with an increased chance of elbow injuries among professional baseball pitchers (Bushwell et al., 2010).

A variety of physiological factors have also been identified as risk factors for professional baseball pitchers (Anz et al., 2010; Byram et al., 2010).

Research Questions:

How does average fastball velocity correlate with injury risk throughout the regular season?

Does a team's pitcher injuries correlate with the number of games won?

If a team has less injuries than it did the season prior, will it perform better than that season?

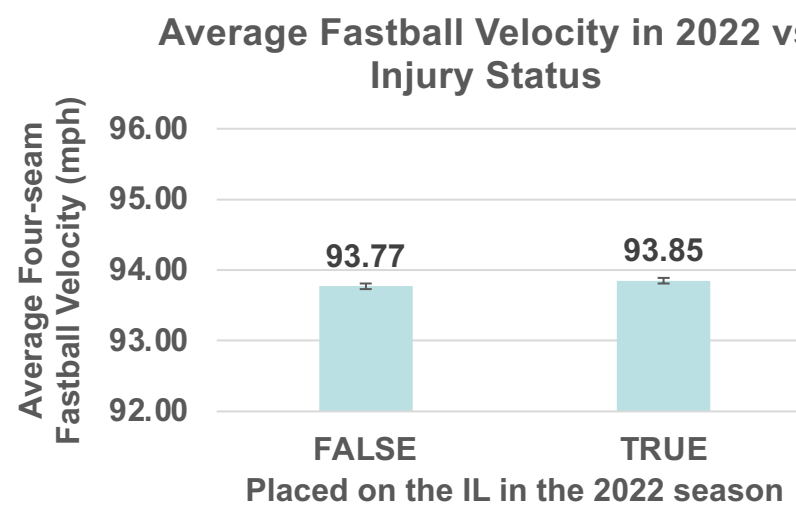
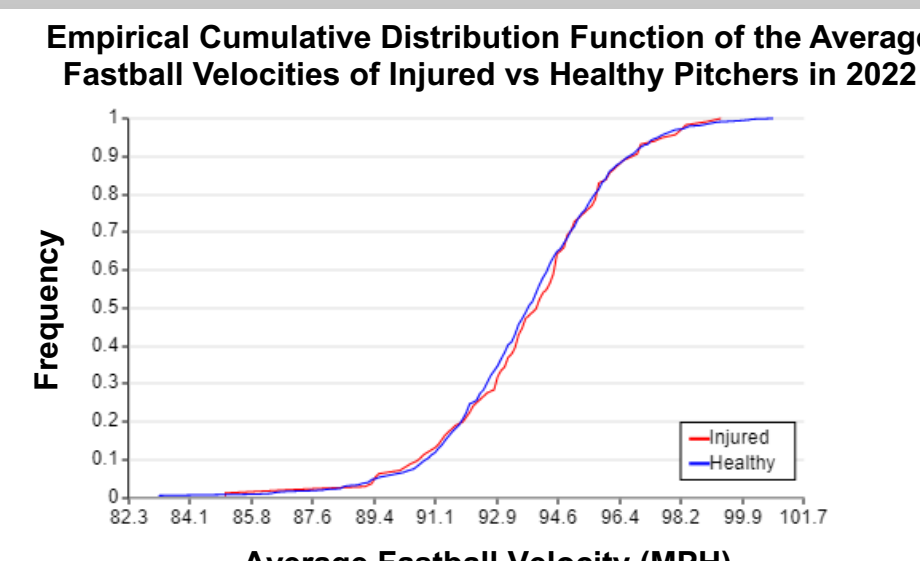
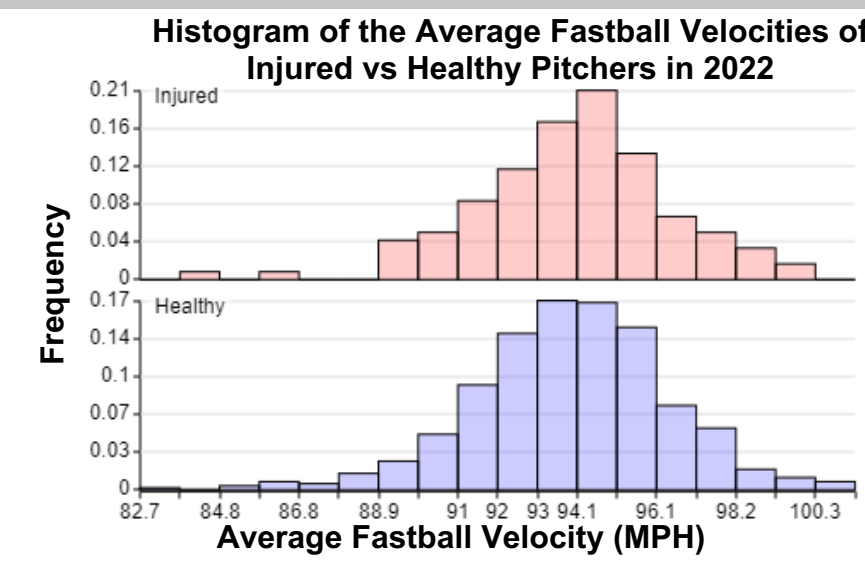
Methods

Use Google's *Statcast* data via Baseball Savant to get the average four-seam fastball velocities of all players who threw at least 50 four-seam fastballs throughout the 2022 MLB regular season. Divide these players into two groups split between those who went on the MLB's injured list (IL) for elbow or shoulder related injuries and those who did not. Pitchers placed on the IL must be out for at least 15 days which filters out less severe pitcher injuries. Compare the distribution of these groups and run a two-sample t-test for the mean of both groups.

For both the 2022 and 2021 MLB seasons, take each pitcher that suffered an elbow or shoulder injury, measure the length of time they spent on the IL and identify for what team they played. For each team, sum the days spent on the IL by all their pitchers to find the total number of days their pitching staff lost to the IL. Using a variety of team stats like fielding-independent pitching (FIP, a one-number stat that quantifies the quality of pitching where lower is better), team wins, and the change in a team's wins from their last season to see how a team's injuries correlates with its success. Also plot the change in a team's days lost to injury from 2021 to 2022 against the change in their win total and the change in their FIP from 2021 to 2022 to see how a change in a team's days lost to injury correlates with their success.

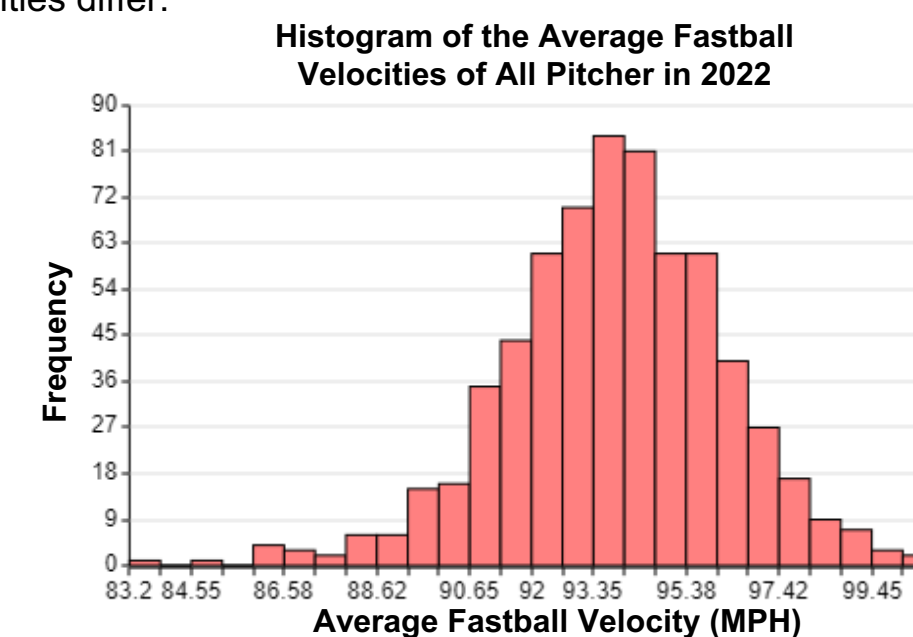
Note: The 2020 MLB season was 60 games long instead of the traditional 162 game season. As such, the win increase data for 2021 is compared to the win total that team would have expected in 2020 should their win percentage be extrapolated out for a full season.

Results

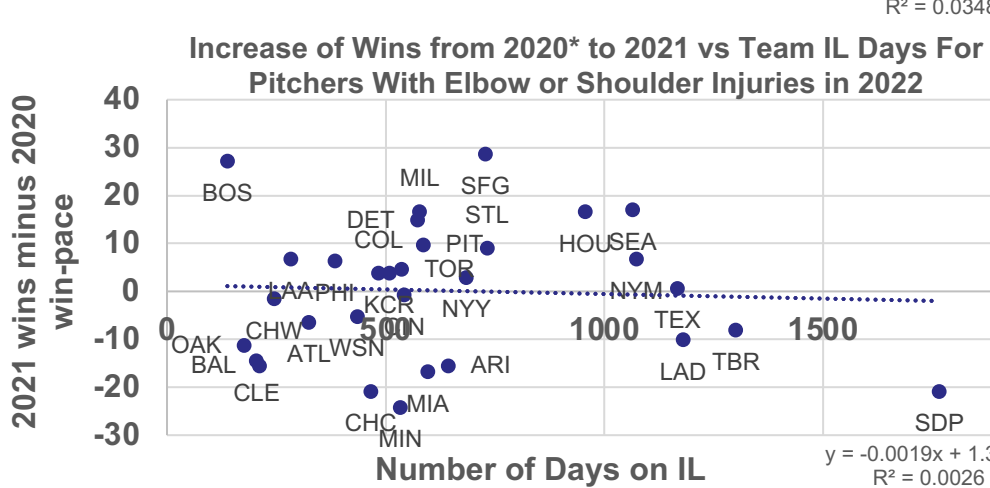
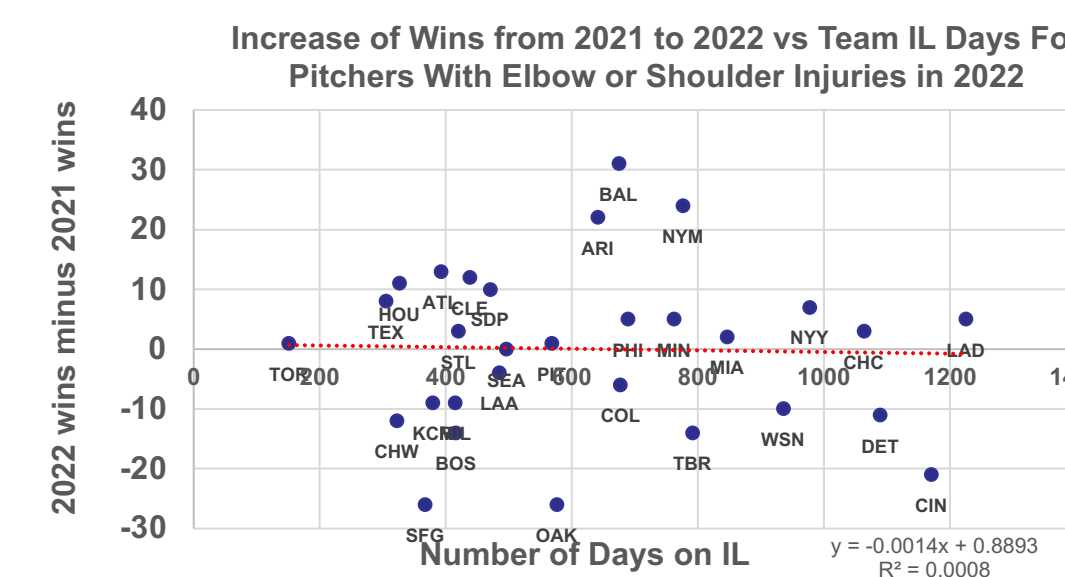
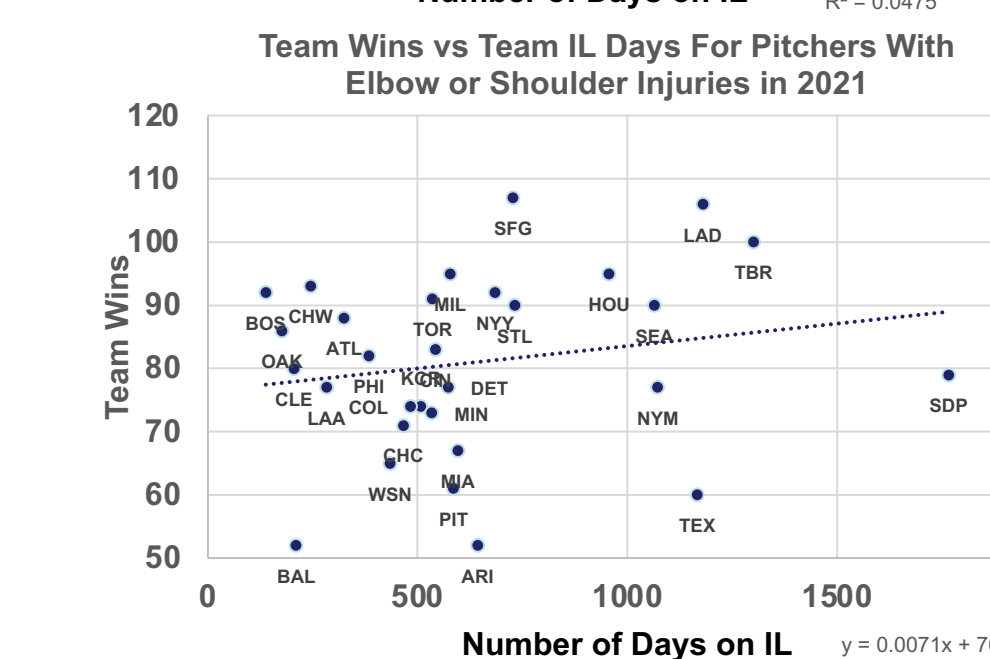
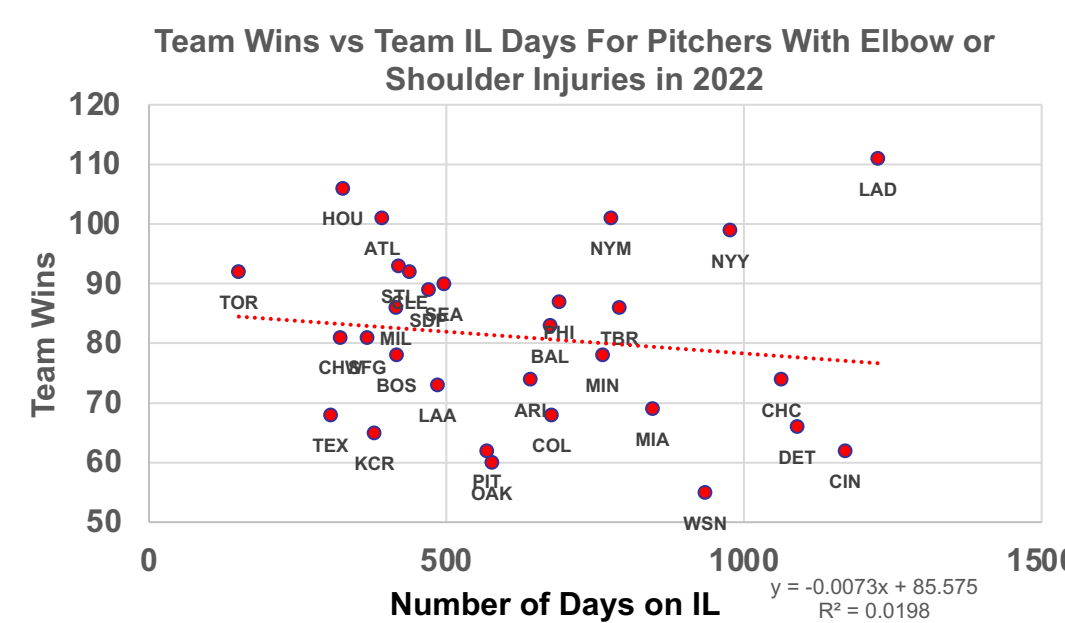
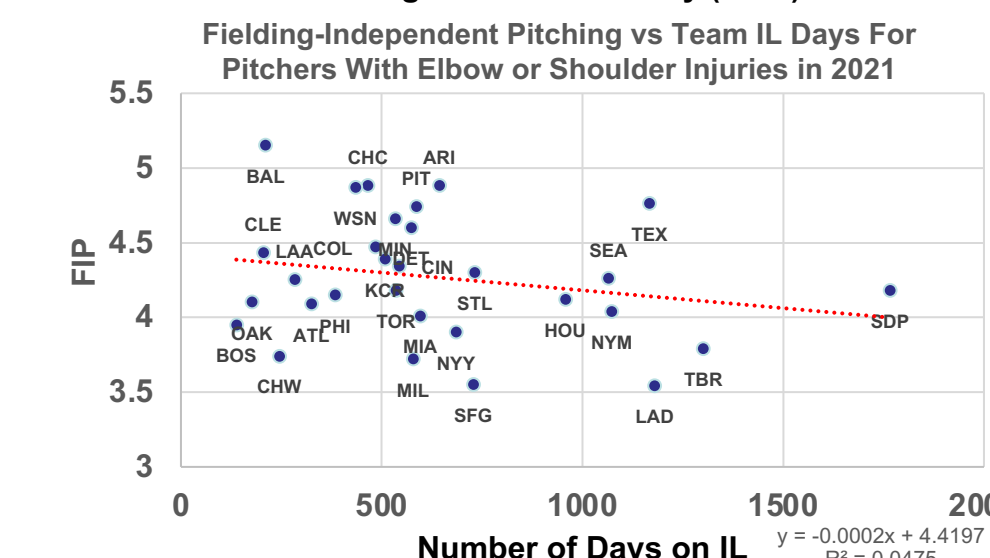
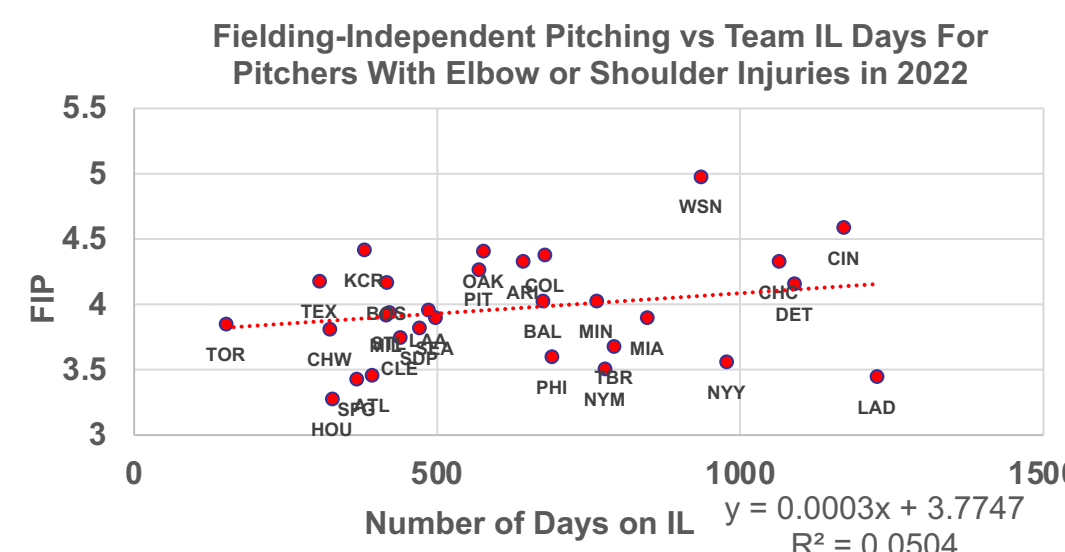


Kolmogorov-Smirnov tests of normality return p values of 0.691 and 0.642 for the injured and healthy data respectively indicating they are normally distributed.

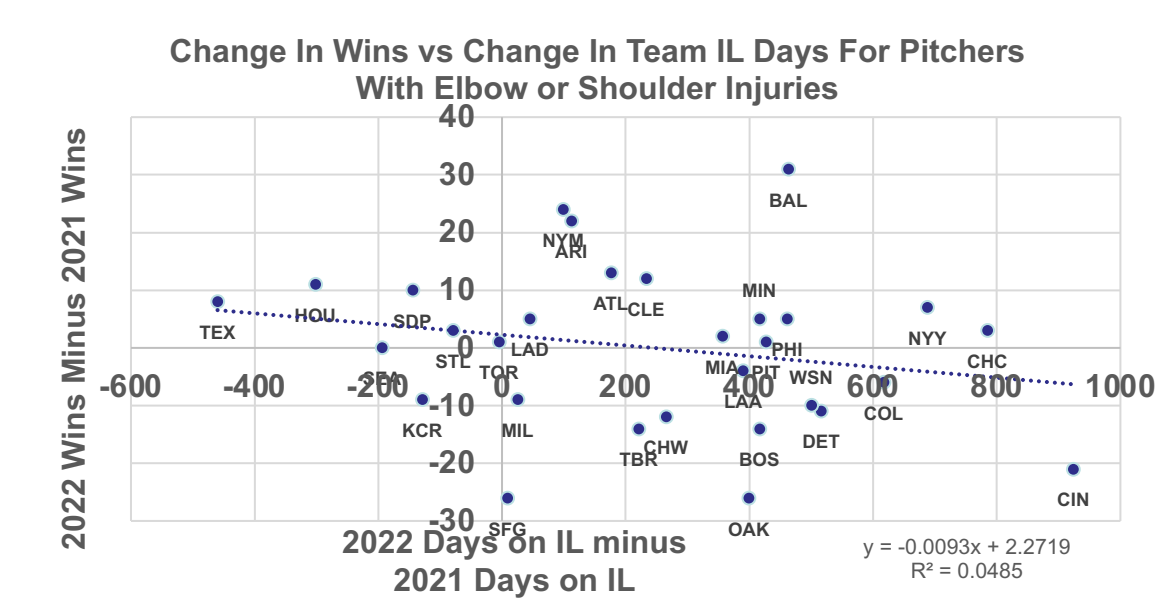
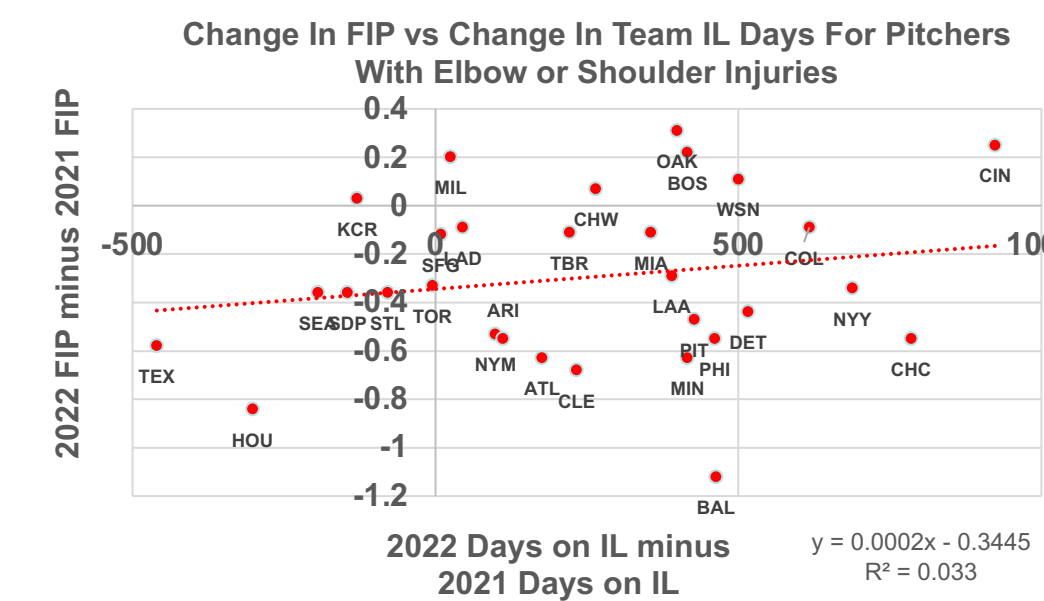
A two-sample t-test to see if the average four-seam fastball velocity of the injured group differs from that of the healthy group returns a p value of 0.748, so there is no evidence to suggest the average four-seam fastball velocities differ.



Kolmogorov-Smirnov tests of normality return a p value of 0.341 indicating the data is normally distributed. A 95% confidence interval for the mean of the average fastball velocity of both injured and healthy pitchers spans from 93.599 to 93.97. A 95% confidence interval for the variance of the average fastball velocity of both injured and healthy pitchers spans from 5.249 to 6.519.



Results



Pearson's Correlation Coefficients:

2022	Injury Days	2021	Injury Days	2022 Minus 2021	Change in Injury Days
FIP	0.224591	FIP	-0.21797	Change in FIP	0.207714
Wins	-0.14069	Wins	0.186485	Change in Wins	-0.12477
Change in Wins	-0.02798	Change in Wins	-0.05573	Change in Wins	-0.12477

	Average Team IL Days For Pitchers With Elbow or Shoulder Injuries
Top Five Teams by Wins in 2022	739.2
Bottom Five Teams by Wins in 2022	725.6
Top Five Teams by Wins in 2021	948.8
Bottom Five Teams by Wins in 2021	608.4

Conclusions

The distribution of the average fastballs of injured and healthy pitchers is remarkably similar and there is no significant difference between the means of the two groups. It would be interesting to test the baseline characteristics to see what confounding variables might be influencing the data, to analyze data beyond the 2022 season, and to factor in injury-severity so a short 15-day IL stint with elbow soreness isn't conflated with season-ending shoulder surgery.

Since the two groups do not show significant difference, analysis of the holistic group reveals the average four-seam fastball velocity is normally distributed. Furthermore, there is 95% confidence that the true population mean falls between 93.599 and 93.97 and that the true population variance falls between 5.249 and 6.519.

The 2022 correlation coefficients suggest that the number of days of manpower a team loses to pitcher elbow and shoulder injuries slightly positively correlates with FIP and slightly negatively correlates with team wins, while the 2021 data suggests the opposite. While both 2022 and 2021 suggest a negative correlation between yearly change in wins and injury days, it is so small as to be negligible. The correlation between the change in injury days and the change in FIP is slightly positive and between the change in injury days and change in wins is slightly negative. As a result of the small sample sizes and the noise of the variety of factors that can affect a team's performance in wins and FIP, there are no conclusions that can be drawn from this data. If this data was collected and analyzed over the course of twenty seasons instead of two, perhaps it would show a stronger correlation either way as the confounding variables are reduced. Instead, there is no clear evidence that there is any correlation between the time a team's pitching staff loses to arm injuries and their success on the field. Other factors show a much stronger correlation with team success.

Citations

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