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Evaluating the Impact of IL Stint Duration on MLB Pitcher Performance



Introduction

Baseball pitchers are especially prone to arm injury due to the demands of their position, often leading to surgeries or extended stints on the Injured List (IL). While some injuries require months to recover, others seem less severe, with players returning after 10–30 days. Is that shorter recovery time truly sufficient? This project investigates **whether an IL stint's duration impacts the pitcher's performance**. By analyzing metrics before and after IL duration, we aim to determine if a significant relationship exists between time spent on the IL and key pitching metrics.



Data

This study uses FanGraphs 2023 - 2024 IL listings data and Baseball Savant 2023 - 2024 pitching metrics. The data focuses on top-ranked pitchers by xwOBA (expected weighted on-base average) with arm-related injuries. After merging by pitcher's name, the data includes 8 pitchers with short IL stints and comparable pre- and post-IL data, resulting in 16 total observations. The dataset has 36 variables covering various information and metrics about the pitcher. The study highlights key pitching metrics like ERA, xwOBA, fastball velocity, and walk rate. The plot below visualizes these changes in the key metrics between pre- and post-IL.

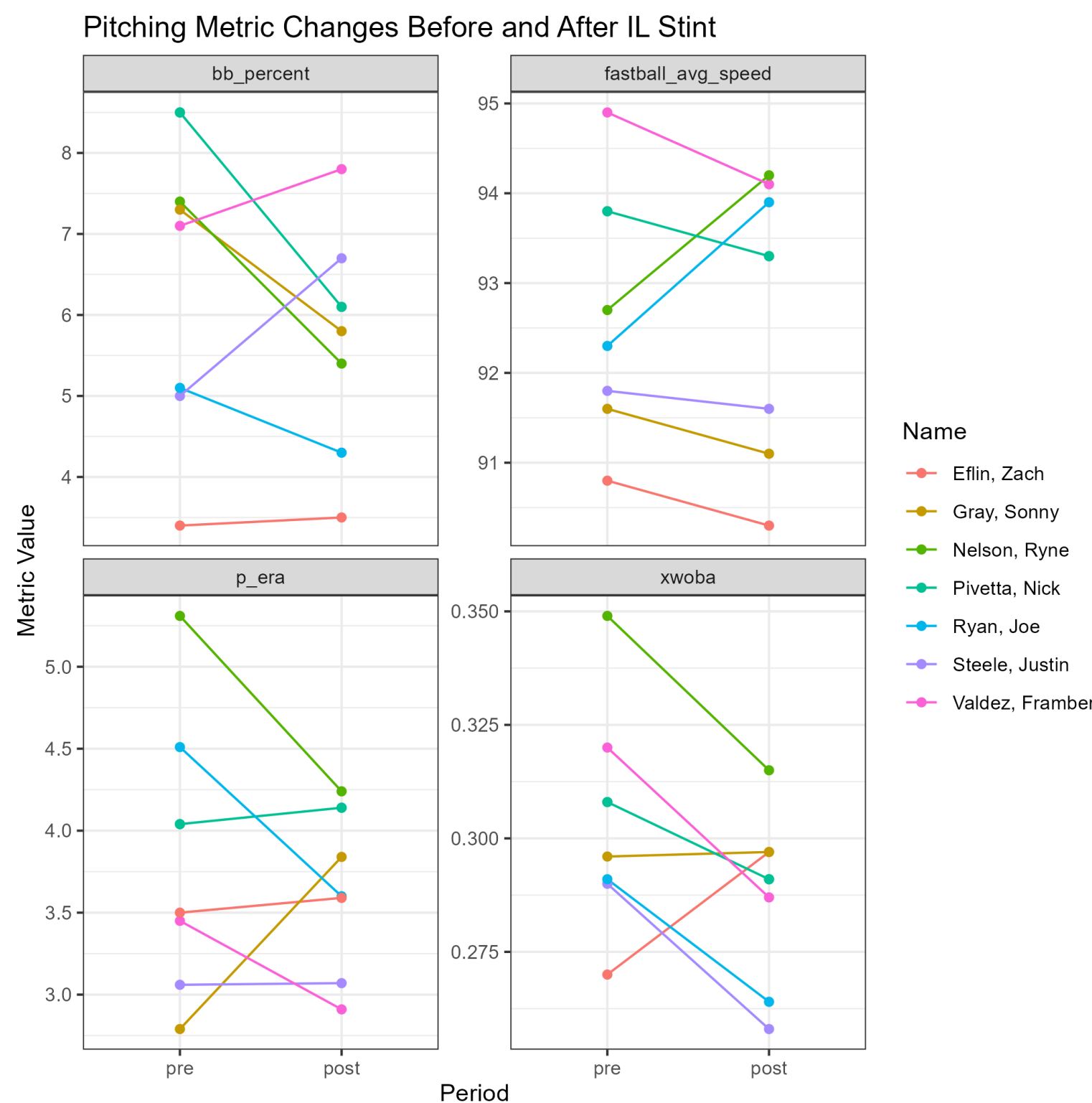


Figure 1. Pre- and post-IL values for four pitching metrics across seven MLB pitchers. Metrics include ERA, xwOBA, Fastball Velocity, Walk%. Lines connect pre-and post-IL status to visualize changes

Methods

To evaluate the impact of injury stints on pitcher performance, we applied two statistical models. First, we use a paired t-test to help determine if there is a significant difference in pitchers' performance before and after an injury stint. Let $X_{i(pre)}$ and $X_{i(post)}$ represent the performance metric for pitcher i before and after the IL stint. The paired t-test evaluates whether the mean difference $D_i = X_{i(post)} - X_{i(pre)}$ significantly differs from zero. For each metric, the null hypothesis states that there is no significant change in the metric before and after IL stint. The alternative hypothesis states that there is a significant change in the metric before and after IL stint. Data is standardized before conducting the analysis to ensure comparability across metrics with different scales.

Next, we fit multiple simple linear regression models to investigate whether there is a linear relationship between the duration of IL and the changes in pitching performance metrics.

The model is defined as: $D_i = \beta_0 + \beta_1 \times \text{Stint}_i + \epsilon_i$

Where:

- D_i is the response variable; the change in a performance metric for player i (post - pre IL stint)
- β_0 is the expected difference when Stint = 0
- β_1 is how much the metric difference changes per unit increase in IL
- Stint_i is the length of the IL stint for player i
- ϵ_i is error term

Results

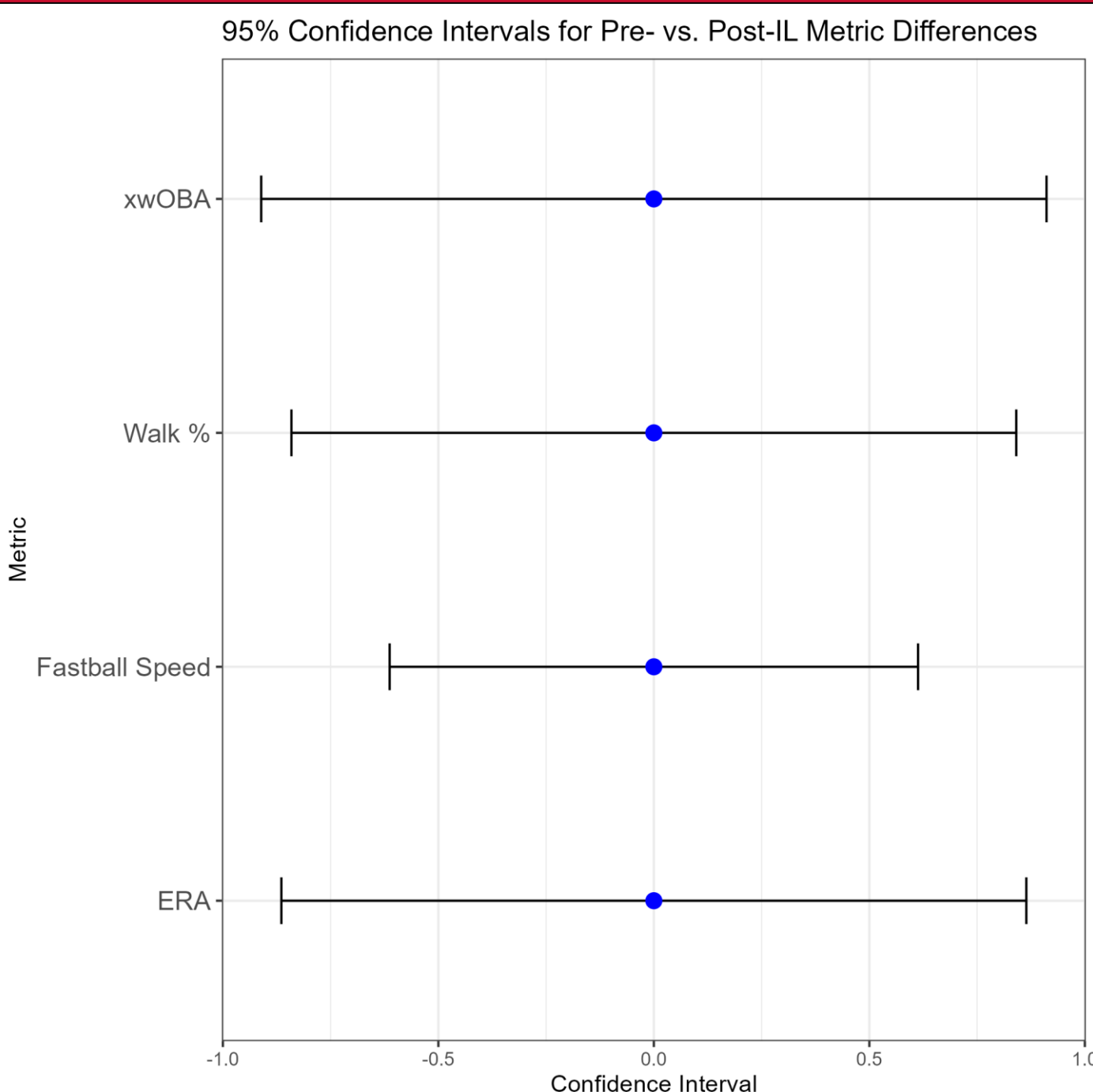


Figure 2. Visualization of 95% confidence intervals for the mean change in each pitching metric from pre- to post-IL. Blue point indicating interval containing zero.

We conducted a paired t-test to compare the four-performance metrics before and after short IL stints. Across all metrics, the 95% confidence interval contained zero, indicating no statistically significant impact on the performance metrics from pre- and post-short IL stint.

- ERA:** 95% Conf. Interval = (-0.86, 0.86)
- xwOBA:** 95% Conf. Interval = (-0.91, 0.91)
- Fastball Velocity:** 95% Conf. Interval = (-0.61, 0.61)
- Walk Percentage:** 95% Conf. Interval = (-0.84, 0.84)

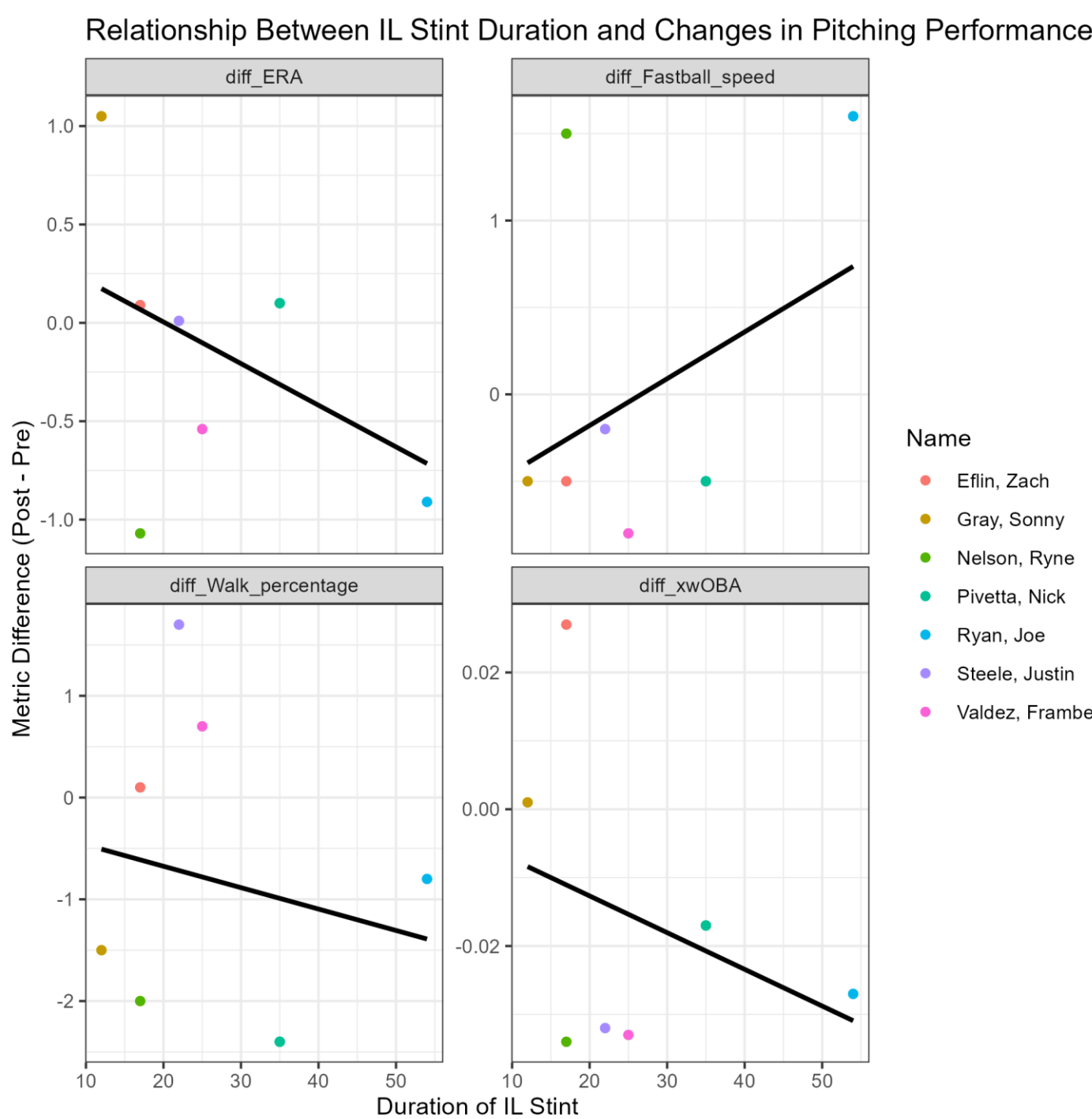


Figure 3. Relationship between IL stint duration and changes in pitching performance metrics. Each point represents a pitcher, and trend lines show the linear regression fit for each metric.

We fit multiple simple linear regression models using IL stint duration to predict changes in the key metrics. Across all metrics, we found no statistically significant evidence that the performance metric is affected by IL stint.

- ERA:** $\beta_1 = -0.02$, $p = 0.28$
- xwOBA:** $\beta_1 = -0.0006$, $p = 0.43$
- Fastball Velocity:** $\beta_1 = 0.03$, $p = 0.30$
- Walk Percentage:** $\beta_1 = -0.01$, $p = 0.83$

Discussion

This study investigates whether a short IL stint's duration impacts the pitcher's performance metrics using paired t-tests and regression modeling. Although no statistical evidence of an impact was found in this study, it highlighted potential trends in our metrics. For example, ERA and Walk percentage showed a slight decrease post-IL stint, which sparks interest in further investigation. Due to the limited availability of data and small sample size, this study is limited in the strength and generalizability of any conclusions. However, these findings justify further exploration in regression modeling with a larger dataset to detect meaningful effects in future work.