

Does in game rest affect pitcher performance?

We've all heard the announcer during a ball game: "Keep in mind how long Price has been sitting in the dugout during this 10-run rally by the offense. He could be rusty when he gets back out there."

The idea doesn't get second guessed because biologically it makes sense; we're taught at a young age in gym class you have to keep your body warm in between exercises. The comment is always made while showing a pitcher sitting in the dugout with his jacket on, perhaps pacing awaiting his turn back on the mound.

Note I know we talked about weather, but maybe we should look based on month and stadium?

Now, if you really sit back and ponder the remark, it doesn't make a whole lot of sense. The pitcher has a team of trainers who would never allow the pitcher to be risking their body regardless of the outcome during their team's batting half of the inning. The pitchers are among the most athletic percent of people in the world, and they're made to pitch and rest in bursts. But what do the results say? Looking at the last three years of data, we can find out if the amount of time sat between pitches has an effect on the pitcher.

Steps taken for individual pitchers:

- Took all pitchers with over 100 innings for years 2014-16.
- Created a formula to determine how much rest between each inning; first by pitches, and then converted to minutes which also takes into account pitching changes. Obviously this is no perfect conversion, but it should give us at least a great estimate: $\text{TimeOfInning} = \text{PaceA} * \text{PitchesA} + \text{PaceB} * \text{PitchesB} \dots \text{PaceN} * \text{PitchesN} + 4 * \text{PitchingChanges} \dots$ where A, B, n are the first, second, and nth pitcher of the half inning. Pace is the average time, in seconds, the pitcher takes in between pitches (per fangraphs). We set the time of a pitching change at four minutes. Obviously, this doesn't take into account commercials and trips to the mound, but that's only because that data was unavailable to us. Our formula should give an accurate measurement of how long the half inning took.
- Split segments of rest to create samples of **short**, **medium**, and **long** instances based on averages.
- For each segment, calculated wOBA for each pitcher for each category of rest.
- Compared differences in performance between rest segments and then averaged all comparisons.
- Split pitchers per year who showed significant performance change between segments.

Results:

There were 72 pitchers who threw at least 100 innings in each of the last three seasons.

Calculated change by looking at differences between each segment of rest (Ex: wOBA in X/(wOBA in X + wOBA in Y where X is segment 1 and Y is segment 2). Then averaged three differences to determine trend.

Significant change was designated by any average above .51 and below .49.

- In 2016, 22 showed significant change for the better in performance with rest and 22 showed significant change for the worse.
- In 2015, 18 performed better with rest, 21 performed worse.
- In 2014, 22 performed better with rest, 19 performed worse.

Next we looked into if any of the 72 pitchers showed consistent effects with rest.

- 66 of the 72 pitchers had at least one season with significant change.
- 24 pitchers had multiple seasons with the same change.
- 5 pitchers showed the same effect with rest all three seasons; 4 with negative performance (Yovani Gallardo, Hisashi Iwakuma, Zack Greinke, Scott Kazmir) and 1 with positive (Jacob deGrom).
- 28 pitchers had at least one season of each positive and negative effect.
- 10 pitchers had two seasons of one effect and a third season of the other.

At this point, we had yet to prove whether or not rest had any correlation to performance but with the data at hand, we wanted to separate these pitchers into categories to see if there were any similarities among the group.

There were 14 pitchers who showed at least two seasons negatively affected by rest. Nine of those had all three seasons with either negative or neutral effect.

Pitcher	2014				2015				2016			
	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins
Ervin Santana	0.31742	0.31858	0.29596	0.36640	0.24958	0.32618	0.38148	0.38980	0.33898	0.29773	0.24140	0.31464
Jorge de la Rosa	0.27433	0.32135	0.34373	0.31973	0.29661	0.32277	0.28460	0.41870	0.34703	0.39601	0.37113	0.36982
Madison Bumgarner	0.23879	0.25392	0.27407	0.29791	0.25946	0.26734	0.28140	0.26691	0.27616	0.22551	0.27560	0.32455
Sonny Gray	0.30672	0.29170	0.21925	0.27589	0.23378	0.28222	0.23548	0.31598	0.31961	0.34626	0.40947	0.38653
Chase Anderson	0.34654	0.38736	0.30985	0.35724	0.32006	0.32042	0.30030	0.43939	0.29929	0.34149	0.39128	0.46166
Yovani Gallardo	0.29578	0.32485	0.29272	0.39085	0.27487	0.31699	0.32705	0.38352	0.33381	0.32937	0.34229	0.37902
Hisashi Iwakuma	0.28621	0.30434	0.21327	0.32535	0.20561	0.28909	0.37627	0.33830	0.30213	0.37900	0.25334	0.41360
Zack Greinke	0.28850	0.25082	0.30858	0.34611	0.21335	0.21033	0.25832	0.24639	0.30896	0.28620	0.30688	0.36555
Scott Kazmir	0.23945	0.31688	0.30539	0.31668	0.29185	0.28113	0.31806	0.34446	0.26326	0.34074	0.32004	0.33745

There were 11 who showed at least two seasons positively affected by rest. Six of those had all three seasons with either positive or neutral effect.

Pitcher	2014				2015				2016			
	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins	0 to 4 mins	4.01 to 6 mins	6.01 to 9 mins	9.01+ mins
Matt Shoemaker	0.36649	0.21517	0.25500	0.30116	0.34870	0.33501	0.31798	0.27178	0.33645	0.28130	0.23368	0.36390
Jose Quintana	0.28545	0.29222	0.28888	0.23073	0.33876	0.28859	0.31350	0.25318	0.28575	0.31730	0.30313	0.30839
Michael Wacha	0.33043	0.28599	0.25986	0.21310	0.27105	0.32451	0.34714	0.22464	0.35543	0.29933	0.28616	0.39315
Jeff Samardzija	0.31073	0.27857	0.30362	0.20207	0.28859	0.34525	0.33866	0.32120	0.27505	0.30797	0.36795	0.23748
David Price	0.24981	0.28298	0.31881	0.25606	0.31141	0.27766	0.27220	0.17963	0.28418	0.30867	0.33901	0.24625
Jacob deGrom	0.27856	0.28725	0.29727	0.11241	0.31309	0.20812	0.25516	0.16496	0.31111	0.30397	0.22186	0.44672

Now that we have these groups, we wanted to see how these pitchers may differ from each other leading to a reason for their similar changes with rest.

What we found was there seemed to be a strong correlation between the type of pitcher and their effect with rest; most notably the correlation seemed to stem from dependence on the fastball (four-seam, two-seam, and cutter). Here are the nine pitchers in the first chart (negative performance with more rest) and their usage of a fastball that season. For reference, these 72 pitchers averaged a rate of 61% fastball usage; to make it easier to reference, we used blue to represent below average and red to show above.

	2014 FB%	2015 FB%	2016 FB%
Ervin Santana	52.20%	52.90%	52.70%
Jorge de la Rosa	63.50%	56.30%	56.60%
Madison Bumgarner	43.50%	49.60%	48.30%
Sonny Gray	55.60%	64.00%	64.00%
Chase Anderson	61.20%	62.00%	62.50%
Yovani Gallardo	55.70%	53.90%	55.70%
Hisashi Iwakuma	47.90%	49.90%	54.60%
Zack Greinke	53.80%	50.70%	48.20%
Scott Kazmir	62.50%	70.00%	64.00%

Here is the same chart for the pitchers who were affected positively by rest.

	2014 FB%	2015 FB%	2016 FB%
Matt Shoemaker	51.30%	56.20%	50.65%
Jose Quintana	62.50%	59.10%	66.80%
Michael Wacha	71.80%	72.60%	70.60%
Jeff Samardzija	67.50%	62.60%	68.20%
David Price	71.40%	69.30%	68.50%
Jacob deGrom	61.50%	61.80%	59.50%

The trend wasn't universal, but there is certainly a relationship for pitchers who rely on the fastball as a heavy part of their repertoire reacting positively to more rest.

Below is the highest and lowest fastball usage for the three seasons reviewed. A higher number under “Rest chg” means the pitcher performed worse with rest. A neutral effect is 0.5.

Highest FB% 2016	Season	FB%	Rest chg
Bartolo Colon	2016	89.50%	0.53309
Jake Arrieta	2016	83.30%	0.52478
Shelby Miller	2016	82.80%	0.52785
Jon Lester	2016	81.80%	0.49480
Mike Leake	2016	77.00%	0.49479
Lowest FB% 2016			
Miguel Gonzalez	2016	47.40%	0.50436
Tom Koehler	2016	46.70%	0.49115
Felix Hernandez	2016	46.30%	0.50378
Jered Weaver	2016	43.50%	0.50027
Masahiro Tanaka	2016	39.60%	0.50429
Highest FB% 2015			
Shelby Miller	2015	88.40%	0.48828
Bartolo Colon	2015	84.20%	0.50496
Corey Kluber	2015	79.80%	0.55511
Jake Arrieta	2015	79.80%	0.49112
Jon Lester	2015	79.50%	0.51814
Lowest FB% 2015			
Jered Weaver	2015	46.90%	0.50169
Francisco Liriano	2015	46.80%	0.48837
Felix Hernandez	2015	43.80%	0.53126
Masahiro Tanaka	2015	43.70%	0.48402
Collin McHugh	2015	33.60%	0.50149
Highest FB% 2014			
Bartolo Colon	2014	82.60%	0.50859
Jon Lester	2014	81.00%	0.49386
Corey Kluber	2014	80.40%	0.47092
Shelby Miller	2014	78.50%	0.49711
Danny Salazar	2014	76.00%	0.49333
Lowest FB% 2014			
Masahiro Tanaka	2014	46.70%	0.50030
Madison Bumgarner	2014	43.50%	0.48157
Felix Hernandez	2014	43.40%	0.50838
Francisco Liriano	2014	42.90%	0.50802
Collin McHugh	2014	40.00%	0.46916

Interesting note on the three outliers here. In 2014, Corey Kluber, one of the league’s heavily dependent on the fastball (including his cutter), proved to be worse with rest and bucked the

trend. But in 2015, even with a similar fastball usage, he had the second highest performance effect with rest.

Shelby Miller had a similar story between 2015 and 16. In 2015, his heavy-fastball usage performed worse with rest, but in 2016 he was much better when rested.

Felix Hernandez had a big change, but in the opposite direction. Hernandez isn't a heavy fastball user, but showed to be much better with rest in 2015. In 2016, he did not fair so well when rested.

Even the outliers that stood out seemed to trend back to our theory.

What can we take out of these discoveries? Perhaps if a team's offense is having a big inning, and the starting pitcher is breaking ball dependent, it may be wise for the manager to get the bullpen going earlier than he normally would. If a team knows it is built on offense, maybe the cheap fireballer free agent is a smart addition as the team's front office knows he will often be heading back out to the mound with a large amount of rest.