Original Article

Professional Baseball Pitchers Drafted at a Younger Age Pitch More Innings During Their Professional Baseball Careers Than Pitchers Drafted at an Older Age

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Purpose: To evaluate and describe the differences in characteristics between the Major League Baseball (MLB) pitchers with greater workload and career longevity in terms of innings pitched (IP) and performance-matched controls who have not experienced similar length careers. **Methods:** Using publicly available data, we identified the top 100 MLB pitchers in terms of career IP. Controls were matched to the top 100 pitchers by draft year and round. Pitchers with fewer than 400 IP were excluded. Demographic information, performance statistics, and injury history were reviewed. Logistic regression analysis and Mann−Whitney *U* tests were used to compare data. **Results:** Compared with controls, the top 100 pitchers in terms of IP were drafted at a younger age (19.35 vs 19.83, $P < .001$) and in later rounds (6.16 vs 2.45, $P < .001$). They made their MLB debut at a younger age (21.77 vs 23.12, $P < .001$). They also pitched fewer innings before debut (470.59 vs 632.07, $P = .007$), were older at their first (30.72 vs 27.50 years, $P < .001$) and second (32.42 vs 29.43 years, $P < .001$) designations to the injured list (IL), and had a significantly longer time from debut to first (3063.50 vs 1565.59 days, $P < .001$) and second (3712.10 vs 2202.03 days, $P < .001$) IL trips. The top 100 pitchers were 7.45 times less likely to have made a trip to the IL within 8 seasons from their debut and were 4.04 times more likely to be younger than 24 years at their major league debut. **Conclusions:** Pitchers with the greatest number of IP in their MLB careers were significantly younger when drafted and when they made their major league debut, although this age difference is likely clinically insignificant. Pitchers who were drafted or debuted at a later age accumulate more pre-debut innings and this may contribute to fewer total IP in the MLB. Similarly, later trips to the injured list and longer duration from debut to first or second trip to the IL, but not total IL trips, are predictive of longer careers compared to age and draft class matched controls. **Level of Evidence:** III, retrospective cohort study.

The overhead throwing motion subjects the shoulder and elbow to significant forces, resulting in a spectrum of overuse injuries, particularly to the throwing arm.[1-3] Injury rates in Major League Baseball (MLB) have increased over the past several decades, resulting in significant career and financial ramifications for players and organizations alike.[4-10] Between 1998 and 2015, injured list (IL) assignments and number of IL days in the MLB increased year to year and players lost a total of 460,432 days due to injury, with an incurred average annual cost of $423,267,634.[11]

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Although several risk factors for throwing-related injury have been identified, including maximum pitch velocity, pitching while fatigued, glenohumeral internal rotation deficit, overall workload, pitch counts, and pitching form, among others, preventive measures have fallen short in reducing injury rates.[9,12-25] Erickson et al.[26] examined the relationship between pitching a complete game and time on the IL, finding that pitchers who threw a complete game spent more time in subsequent seasons on the IL than did matched controls who did not throw a complete game. Moreover, several studies have focused on the positive correlation between pitch count and injury at a variety of baseball levels,[10,20,27] although there is conflicting evidence regarding the use of pitch counts to decrease injury rates specifically in professional baseball players.[28-30]

The purpose of this study was to evaluate and describe the differences in characteristics between the MLB pitchers with greater workload and career longevity in terms of innings pitched and performance-matched controls who have not experienced similar length careers. The authors hypothesized that the pitchers with greater longevity would differ from controls in regard to workload before MLB debut.

Methods

The 100 MLB pitchers from the modern era (1965-2019) with the most total career innings pitched were identified with publicly available data (Baseball-Reference.com, Fangraphs.com, and ProSportsTransactions.com), therefore obviating the need for institutional review board approval. This search methodology was successfully used in previous studies by multiple authors evaluating injuries in MLB pitchers.[6,26,31-34] These players were designated as "cases." Control pitchers were matched to the case group by draft year and round to control for age and skill level. In addition, only pitchers with a minimum of 400 total career innings pitched were included as controls. Of these pitchers, the top 227 pitchers in terms of earned run average were selected as final controls to maintain a 2:1 ratio of controls to cases.

A total of 327 pitchers were included. Demographic information, performance statistics, and injury history from each player's minor, major, independent, and foreign league career were reviewed (Table 1). Additional variables collected included innings pitched before debut season (defined as the year in which a player made his debut in the Major League), innings pitched after debut season, games before debut season, and games after debut season. For players who are currently active, we included data up to and including their 2019 season. Injury data were limited to injuries incurred during a player's MLB career. Injury classification and IL designation data were collected, as shown in Table 2.

Table 1. Performance Variables Collected for Cases and Controls

	Minor League	Major League	Other*
Innings pitched	✔	✔	✔
Seasons	✔	✔	✔
Games	✔	✔	✔
Innings pitched per season	✔	✔	✔
Innings pitched per game	✔	✔	✔
Wins	✔	✔	✔
Losses	✔	✔	✔
Earned run average	✔	✔	✔
Walks and hits per inning pitched	✔	✔	✔
Postseason games		✔	
Postseason innings		✔	

*Includes various foreign and domestic professional leagues.

Statistical Analysis

Descriptive statistics were calculated for each group. Data were nonnormally distributed; thus, nonparametric tests were used. Year, innings pitched, number of days on the IL, and number of other seasons on the IL were compared between study group and controls with Mann–Whitney U tests. All analyses were conducted in Excel (Microsoft, Redmon, WA) and SPSS (version 23; IBM Corp., Armonk, NY).

Results

Descriptive demographics and data are presented in Table 3. There were no significant differences in age, body mass index (BMI), home state, or total trips to the IL between cases and controls. There were significant differences in draft age and draft round, with cases being drafted at a younger age (19.35 vs 19.83, $P < .001$) and in later rounds (6.16 vs 2.45, $P < .001$). Cases were also significantly younger at MLB debut (21.77 vs 23.12, $P < .001$). Controls pitched significantly more innings before their debut (632.07 vs 470.59, $P = .007$). Controls were significantly younger at their first (27.50 years vs 30.72 years, $P < .001$) and second (29.43 years vs 32.42 years, $P < .001$) designations to the IL and had a significantly shorter time from debut to first (1565.59 days vs 3063.50 days, $P < .001$) and second (2202.03 days vs 3712.10 days, $P < .001$) IL trips.

Using logistic regression analysis (Table 4), cases were 7.45 times less likely to have made a trip to the IL within 8 seasons/years from their debut and were 4.04 times more likely to be younger than 24 years at their major league debut.

Discussion

MLB pitchers with greater longevity were placed on the IL for the first time at a significantly older age and significantly longer interval from MLB debut compared with controls. Pitchers with long careers were 7.45 times less likely to have made a trip to the IL in their first 8 years after their major league debut and

Table 2. Injury Classification and Demographics

Injury Type	Disabled List Time	Demographics
Elbow	Day to day	Handedness (right vs left)
Throwing		
Nonthrowing		
Shoulder	10-day	Draft year
Throwing		
Nonthrowing		
Lower body (e.g., foot, ankle, knee, hamstring, etc.)	15-day	Draft round
Other upper extremity (e.g., hand, wrist, finger, etc.)	21-day	Age at start of career
Spine	60-day	Age at end of career
Other	Total IL trips	Height (in.) at start of career
		Weight (lbs.) at start of career
		Age at MLB debut
		Birth date
		MLB debut date
		Home state/country

IL, injury list; MLB, Major League Baseball.

greater than 4 times more likely to be younger than 24 years old at debut. These findings potentially suggest that sustaining a serious injury that necessitates designation to the IL earlier on in a pitcher's career, regardless of injury type, may have profound career longevity implications.

The heterogeneity of factors and outcomes discussed in this study and others and the conflicting results surrounding increased pitching workload and its relation to injury and performance, suggests that a wider array of metrics may help in determining durability. Bakshi et al.[28] conducted a systematic review of pitchers across different ages and skill levels to find the relation between workload and injury and found evidence that use of pitch counts can reduce injury rates in Little League and high school pitchers, but found conflicting evidence when looking into the use of pitch counts in college and professional baseball pitchers. We focused solely on innings pitched in professional major league pitchers because of the availability of the data and the ability to identify age and draft matched controls.

We found no association between BMI and durability of pitchers or injury. Forsythe et al.[35] looked at physical size and BMI of major league pitchers and found that increases in physical size required more medical attention, training, and management because of increased force and ball velocities, and their association with injury. Furthermore, we found no significant differences between cases and controls comparing home state.

On average, controls were drafted at an older age than cases and made their MLB debut at an older age. This result is supported by Witnauer et al.,[36] who found that professional baseball players who began their career at a younger age had a longer career length than those who began later. This may be due in part to peak performance of baseball players occurring between age 25 and 31.[37] Alternatively, older pitchers will have more seasons of competition in their arms prior to reaching the majors. The pitchers in our control group therefore had significantly more innings pitches prior to debut as well. The authors hypothesize that this increased cumulative workload early on may have contributed to limiting the overall length of that career.

We found that the pitchers with greater longevity were drafted in significantly later rounds compared to the controls. In theory, players with greater potential are chosen earlier than less-skilled players. However, many variables are involved in how successful a player becomes. Players drafted in earlier rounds have a greater probability of both reaching and playing in the majors for more than 3 years.[38] The effect this has on longevity in baseball is difficult to surmise. The combination of older age at draft and debut in combination with being drafted in earlier rounds can lead to increased pressure on the both the pitcher and the team to advance the player, resulting in a greater workload. The authors ensured that pitchers designated as controls were drafted in the same round as cases in order to help limit performance bias in the length of career.

Innings pitched before debut in the MLB and its association with durability and injury to the throwing arm due to increased pitching volume was found to be a significant factor in our analysis. The cases in our study had significantly less innings pitched prior to debut when compared with controls (288.72 vs 350.10

Table 3. Descriptive Demographics and Data for Cases and Matched Controls

Demographics	Cases	Controls	*T* test *P* Value
Draft age, y	19.35	19.83	<.001
Draft round	6.16	2.45	<.001
BMI	25.20	25.72	.117
Minor innings pitched	470.59	632.07	<.001
Innings pitched prior to debut	288.72	350.10	.007
Debut age, y	21.77	23.12	<.001
Major innings pitched	2,912.46	757.81	<.001
Majors ERA	3.78	4.16	<.001
Majors WHIP	1.29	1.40	<.001
Warm weather states	0.13	0.16	.494
Time from debut to first IL, d	3,063.50	1,565.59	<.001
Age of first IL	30.72	27.50	<.001
Time from debut to second IL, d	3,712.10	2,202.03	<.001
Total IL trips	3.57	3.40	.664

BMI, body mass index; ERA, earned run average; IL, injury list; WHIP, walks and hits per inning pitched.

Table 4. Time and Age From Debut to IL for Cases and Matched Controls

	Controls N = 158	Cases N = 86	Odds Ratio	*P* Value
Time in seasons to IL from debut	4.53 (3.38)	8.89 (5.31)	1.26 (1.17-1.36)	<.001
	N = 227	N = 100		
Debut age, y	23.1 (2.18)	21.8 (1.55)	1.47 (1.27-1.70)	<.001

IL, injury list.
The numbers in parentheses represent standard deviations.

innings, respectively; $P = .007$). Hardy et al.[39] analyzed the number of innings pitched before the age of 25 years compared with after the age of 25 years and found a positive relationship between the greater number of innings pitched before age 25 years and career length. Saltzman et al.[40] also analyzed similar data but found no correlation between innings pitched and being placed on the IL. Both studies had a narrow range of players that were studied, and players were chosen only from a range of a few years. In our study, we identified that controls, who had shorter careers, pitched significantly more innings before their debut in the MLB when compared with our cases, who had longer, more successful careers.

Time from major league debut and age at first and second trip to the IL was the most important factor in predicting length of career in our analysis. In fact, pitchers with the longest careers in MLB history were more than 7 times less likely to have made a trip to the IL within their first 8 seasons from their debut. No study to date has looked at age at first trip to IL or overall service time before IL designation. It is likely that time spent on the IL earlier in a career or at a younger age is the result of earlier accumulation of damage and may affect mechanics and workload. Together, our data represent a lower pre-debut workload that we believe contributes to a longer, more durable career.

The findings of this study indicate that players who were drafted at a younger age pitched more innings in professional baseball than those drafted at a later age. This is relevant when teams are considering which players to draft/sign as it can be difficult to predict career length. While many factors contribute to the number of innings a player pitches in professional baseball, draft age is one that should be considered moving forward.

Limitations

This study has several limitations. Although obtaining data from publicly available sources has been used in many previous studies, it is still subject to reporting and observer bias. Durability and longevity may be closely related but are not synonymous and, therefore, other factors may affect our outcome measures. While we took extensive measures to attempt to control for performance-related differences, we cannot exclude those from playing a role. Finally, some controls who had extremely short careers were excluded, to limit the flame-out effect. We felt that limiting controls to those with at least 400 career innings pitched was a more representative comparison and reflected a pitcher's ability to remain in the majors long enough to establish a career.

Conclusions

Pitchers with the greatest number of innings pitched were significantly younger when drafted and when they made their major league debut, although this age difference is likely clinically insignificant. Pitchers who were drafted or debuted at a later age accumulate more pre-debut innings and this may contribute to fewer total innings pitched in the MLB. Similarly, later trips to the IL and longer duration from debut to first or second trip to the IL, but not total IL trips, are predictive of longer careers compared with age- and draft class–matched controls.

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