



MAJOR LEAGUE BASEBALL

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M E M O R A N D U M

**TO:** General Managers  
Assistant General Managers  
Farm Directors  
Domestic and International Scouting Directors  
Club Medical & Performance Staff

**FROM:** Office of the Commissioner

**DATE:** December 17, 2024

**RE:** MLB Report on Pitcher Injuries

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Attached please find the MLB Report on Pitcher Injuries. In response to the long-term increase in pitcher injuries at the amateur and professional levels, MLB interviewed more than 200 subject-matter experts from a variety of disciplines across all levels of the sport to better understand the industry's perspectives on factors that have contributed to this increase over the past several decades.

We view the Report as an important first step in a longer process to identify the root causes of pitcher injuries and effective solutions to address this serious concern for the game. While the Report provides valuable qualitative insight on current expert opinion and proposes several steps to improve overall pitcher health, the Report also recommends additional quantitative research needed to further our understanding of this complex problem and identify remedial solutions. We will now begin the next phase of this initiative, including a detailed examination of offseason training regimens and early season workloads, given the recent increase in early-season injuries (*see* Report, Figure 7), and other research initiatives recommended by those interviewed for the Report (*see* Section V).

We want to thank everyone who contributed to this Report, which includes input from all 30 Clubs. Pitcher health is a critical issue for the future of baseball, and we know player health and safety is of utmost importance to this group. We welcome any feedback or suggestions as we continue this work, and we appreciate all of your support.



## MLB REPORT ON PITCHER INJURIES

December 2024

### I. Executive Summary

This spring, some of Major League Baseball’s most popular and accomplished pitchers – including former Cy Young Award winner Shane Bieber and Atlanta Braves ace Spencer Strider, who finished fourth in the Cy Young voting in 2023 – suffered elbow injuries that required surgery and kept them out for most or all of the 2024 season. Even baseball’s brightest young stars have not been immune – Miami Marlins pitcher Eury Pérez, who finished in the top 10 of Rookie of the Year voting in 2023, also was injured. And although Shohei Ohtani was one of MLB’s most productive hitters this past season, the former MVP also underwent elbow surgery last September that kept him off of the mound entirely in 2024.

This recent spate of injuries to high profile pitchers has brought renewed attention to pitcher health. But these events are unfortunately just a continuation of a long-term trend. In fact, injuries sustained by pitchers in professional and amateur baseball have increased substantially over the past several decades. Ten years ago, an article in USA Today called ulnar collateral ligament (“UCL”) surgeries “an epidemic,” as a result of the injuries sustained by pitchers Adam Wainwright, Stephen Strasburg, and Francisco Liriano.<sup>1</sup> And in 2015, ESPN published an article with a fatalist title that appeared to accept “why pitchers will always have Tommy John surgery.”<sup>2</sup> Published in 2016, *The Arm* described many of the same issues that are not only still present today, but that have further worsened.<sup>3</sup> These surgeries often carry recovery times of over 12 months, meaning that fans may go longer than a season without seeing their team’s star player pitch in a game.

In response to these concerns, Major League Baseball commissioned this study in fall of 2023 to identify factors that have contributed to increases in pitcher injuries and recommend future areas of study to reduce injuries and improve health for players at all levels of baseball. In furtherance of this study, MLB interviewed over 200 subject matter experts, including former professional pitchers, orthopedic surgeons, athletic trainers, Club officials, biomechanists, player agents, amateur baseball stakeholders, and other experts in pitcher development. Based on these interviews, we conclude that although the potential contributors are complex and many factors are still unknown, the most significant causes are likely the increased velocity of pitches, the emphasis on optimizing “stuff” (a term referencing the composite movement characteristics of pitches, including horizontal and vertical break and spin rate), and the modern pitcher’s focus on exerting maximum effort while pitching in both game and non-game situations. Some experts speculated on the potential influence of other factors on the short-term increase in injuries over the past several

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<sup>1</sup> Ortiz J. Tommy John Surgery Now “an Epidemic.” *USA TODAY* (2014).

<sup>2</sup> Miller S. Why Tommy John Surgeries Won’t Cease Any Time Soon. *ESPN* (2015).

<sup>3</sup> Passan J. *The Arm*. HarperCollins (2016).

years, including the lasting effect of COVID-impacted seasons, the introduction of the pitch clock, and perceived inconsistencies in the surface grip of the baseball. There was not sufficient consensus or evidence to establish a link between these other factors and pitcher injuries, but we will continue to monitor these issues to determine whether there is any additional evidence to support these theories over time.

In amateur baseball, younger pitchers have similarly adopted the pursuit of velocity, “stuff,” and a max-effort style of pitching and training, even though these practices may be inappropriate at such young ages. The risks of arm injury due to overuse largely have been ignored in favor of year-round travel baseball and showcases (a longstanding concern with amateur baseball that experts view as only worsening in recent years). Indeed, high-level amateur players perform year-round with intense pitching schedules that put them at greater risk of future injury. Although some suggest that current youth and amateur development models may be primarily responsible for an increase in pitcher injuries across all levels, we conclude that improving pitcher health requires both adjusting professional incentives and implementing changes to amateur baseball so that appropriate training and performance practices trickle down to the amateur level.

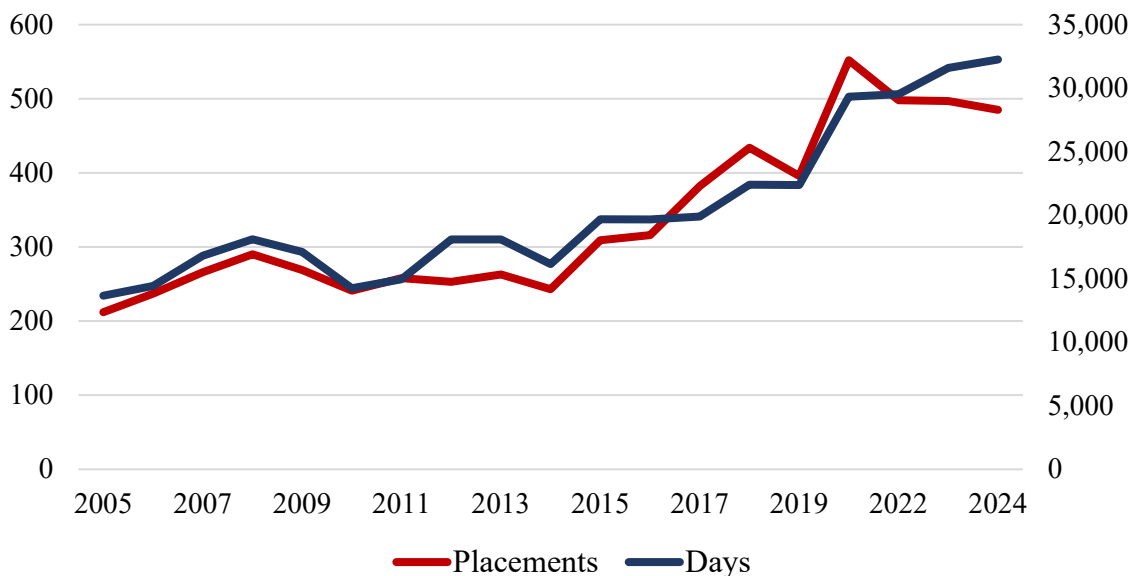
Finally, we note that the primary injury factors – the focus on velocity, “stuff,” and max-effort pitching – have caused a noticeable and detrimental impact on the quality of the game on the field. Current pitching practices are focused on the prevention of run-scoring through the accumulation of strikeouts; such trends are inherently counter to contact-oriented approaches that create more balls in play and result in the type of on-field action that fans want to see. The prominence of the starting pitcher has diminished as modern pitchers have developed to throw harder over shorter stints. Starters and relievers alike are incentivized by the competitive and economic rewards of chasing velocity and “stuff,” regardless of the significant risks that may keep them off the field. Importantly, we find that pitchers at the professional level are at least somewhat aware of these injury risks but are choosing this more dangerous style of pitching because they perceive that the rewards outweigh the risks, particularly in the near-term.

Based on the results of this study, we propose certain steps to improve pitcher health at all levels of baseball. We recommend considering rule changes at the professional level that shift the incentives for Clubs and pitchers to prioritize health and longevity. We also suggest changes to amateur baseball systems, which contribute to elevated injury risks at the professional level; but, we caution that any amateur-specific initiatives will have limited impact in isolation. Because amateur players will generally strive to model their own behavior after professional players, training and development practices in the Major Leagues and Minor Leagues will need to be adjusted before meaningful change at the amateur level will be possible. And we recommend additional research in a number of areas in response to concerns raised by experts interviewed for this report. We are hopeful that this research will help to identify the root causes of pitcher injuries and lead to effective solutions that address this serious problem for the game.

## II. Introduction

Pitcher injuries in professional and amateur baseball have increased dramatically over the past several decades. Major League Injured List (“IL”) placements and days on the IL for pitchers have risen steadily over the past twenty years. *See* Figure 1. These trends persist even after accounting for roster and transaction changes that, in theory, should have decreased the number of IL placements, including an increase in the minimum duration of IL placements for pitchers and an increase in the overall size of active rosters.

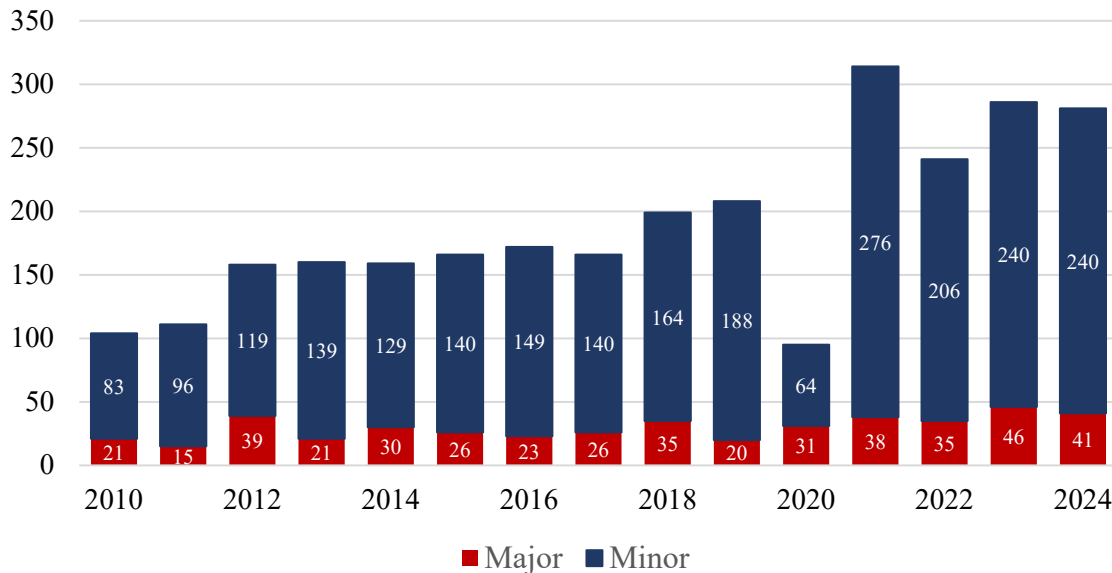
**Figure 1: Major League Pitcher IL Placements and Days, 2005-2024<sup>†</sup>**



In addition to an increase in Major League IL placements, instances of significant pitcher injuries also have increased. At both the Major and Minor League levels, the number of ulnar collateral ligament surgeries (including UCL reconstruction, commonly known as “Tommy John” surgery, and the more recently introduced UCL repair), which typically require more than a year of rehabilitation to return to competitive play, has grown rapidly since the early 2010s. Indeed, the significant increase in Minor League UCL surgeries since 2021 is particularly stark in the context of the reorganization and modernization of Minor League Baseball (also known as the “Professional Development League” or “PDL”), which decreased the total number of affiliated Minor League teams and rostered players. Despite the decrease in the total number of Minor League players, total UCL surgeries have spiked in recent years. *See* Figure 2.

<sup>†</sup> Excludes 2020 season

**Figure 2: Major League and Minor League UCL Surgeries, 2010-2024**



To study this increase in injuries, we spoke to over 200 industry experts, including former professional pitchers, orthopedic surgeons, athletic trainers, Club officials, biomechanists, amateur baseball stakeholders, other experts in pitcher development, and executives at all levels of professional and amateur baseball.<sup>4</sup>

The following report summarizes feedback from industry experts, who identified numerous and varied potential contributors to the rise in pitcher injuries.<sup>5</sup> These contributors can be categorized primarily into two frameworks: (A) trends in training and performance in professional baseball (the Major and Minor Leagues); and (B) related trends in the development of youth players in amateur baseball. We discuss the contributors and associated conclusions of each in turn.

### **III. Contributors to the Rise in Pitcher Injuries**

#### *A. Professional Baseball*

The vast majority of experts who participated in this study concluded that the pursuit of higher velocity, the development of “stuff” and pitch design, and max-effort training and performance are the primary factors that have contributed to the long-term increase in pitcher injuries in professional baseball. Some experts suggested more recent developments, such as the

<sup>4</sup> Unless otherwise noted, all block quotes are from interviews conducted with these experts.

<sup>5</sup> This report also reflects feedback and insights from industry leaders and front office staff from all thirty Major League Clubs that were not collected through formal interview.

introduction of the pitch clock and the surface of the baseball (*i.e.*, the ability to grip the baseball) as other potential contributors, but there was not a wide consensus on the relevance of these factors in part because the injury rate was increasing prior to the implementation of these changes, and then has remained steady since these factors were introduced. Respondents also noted that strategic priorities of professional baseball teams, including roster construction and pitcher usage, may play a role.

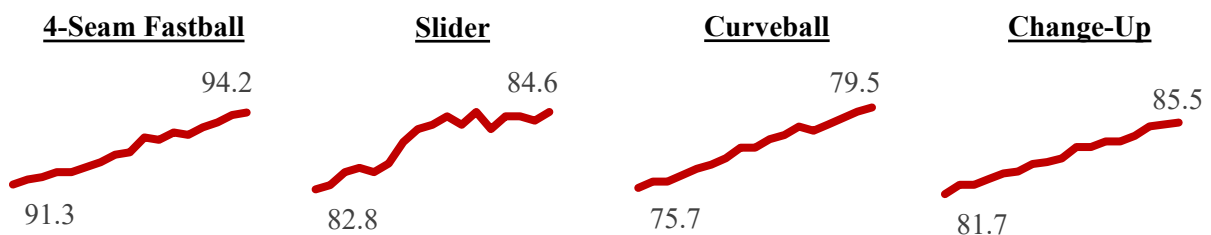
### 1. Velocity, “Stuff,” and Max-Effort Throwing

Experts overwhelmingly agreed that contemporary pitchers in professional baseball prioritize the pursuit of velocity and “stuff” (a term that describes composite movement characteristics of pitches including horizontal movement, vertical movement, and spin rate) in their training and performance, and that this leads to increased injury risk. Moreover, most professional pitchers are expected to (and actually do) pitch at max- or near-max-effort for nearly the entirety of their appearances in professional games, which has been accompanied by a noticeable change in the type and intensity of training, including during the offseason.

#### *a. Velocity*

Despite a direct correlation with injury risk (set forth in further detail below), pitch velocity has increased since in-game data first became widely available. At the Major League level, fastball and non-fastball velocities have steadily climbed since 2008. *See* Figure 3. As a result, fastball and non-fastball pitches impart more stress to pitchers’ arms than they have in the past. Although pitchers in aggregate have achieved higher thresholds of pitch velocity, this increasing trend in pitch velocity is also attributable in part to pitchers throwing more pitches with maximum effort.

**Figure 3: Average Major League Fastball and Non-Fastball Velocity, 2008-2024**



Velocity has been pursued by pitchers because it is advantageous in achieving positive performance outcomes, can be quantified and acquired, and is valued by Major League Clubs. Private facilities that specialize in velocity-focused methods of training have grown in popularity.

For nearly 30 years, biomechanical researchers have described a positive association between elbow torque and pitch velocity.<sup>6,7</sup> This principle remains a focus of academic research today, as described by one leading biomechanist who specializes in baseball performance and research:

“A lot of the research we do is focused on biomechanics and torque on the elbow and shoulder. To me, those are the big injury drivers . . . the higher the ball velocity, the more stress there is on the elbow and shoulder. The nature of the way those values are calculated, the faster the arm is moving, the higher that value is. That’s what everyone is chasing to be noticed.” (Biomechanist and Academic Researcher #1)

More recent studies have demonstrated that the magnitude of the relationship between elbow stress and velocity varies across pitchers, but that all pitchers experience greater stress as velocity increases.<sup>8,9,10</sup> In other words, although not every pitcher experiences the same torque increase with each mile per hour increase in the velocity of a pitch, each individual pitcher experiences greater elbow torque when throwing a fastball at 95 mph, for instance, than at 94 mph.

The industry experts we spoke to concurred with the medical research and overwhelmingly identified velocity as the primary factor leading to the increase in pitcher injuries. As velocity increases, torque on the elbow also increases.

“I think there are a lot of factors. There’s no question that if we take the simplest thing, which is fastball velocity, you can see how the average increase in fastball velocity has completely paralleled the increased incidence of injury. If you could take one factor, it’s that.” (Orthopedic Surgeon #1)

“Yeah, no doubt, velocity is the biggest thing.” (Independent Pitching Development Coach #1)

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<sup>6</sup> Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF. Kinetics of Baseball Pitching with Implications About Injury Mechanisms. *American Journal of Sports Medicine* (1995).

<sup>7</sup> McCutcheon TW, Slowik JS, Fleisig GS. Kinematics Associated with Elbow Varus Torque in Baseball Pitchers. *Orthopaedic Journal of Sports Medicine* (Accepted for Publication).

<sup>8</sup> Slowik JS, Aune KT, Diffendaffer AZ, Cain EL, Dugas JR, Fleisig GS. Fastball Velocity and Elbow-Varus Torque in Professional Baseball Pitchers. *Journal of Athletic Training* (2019).

<sup>9</sup> Nicholson K, Hulburt T, Beck EC, Waterman BR, Bullock GS. The Relationship Between Pitch Velocity and Shoulder Distraction Force and Elbow Valgus Torque in Collegiate and High School Pitchers. *Journal of Shoulder and Elbow Surgery* (2020).

<sup>10</sup> Sakurai M, Barrack AJ, Lobb NJ, Wee CP, Diaz PR, Michener LA, Karduna AR. Collegiate Baseball Pitchers Demonstrate a Relationship between Ball Velocity and Elbow Varus Torque, Both Within and Across Pitchers. *Sports Biomechanics* (2023).

“Increased velocity is one [factor], and obviously the biggest one.” (Orthopedic Surgeon #2)

“I would say the greatest injury risk today is increased velocity.” (Former Major League Pitcher #1)

“Obviously, there’s no doubt that max-effort throwing or velocity is the number one factor in UCL injuries.” (Orthopedic Surgeon #3)

“I think overall, there’s been an increase in injuries due to guys throwing harder.” (Major League Pitching Coach #1)

“Anybody who works in baseball agrees on the main driver of pitching injuries – velocity. Velocity places more stress on the elbow. It’s the recipe of success. This is taking place at all levels. We’re seeing a domino effect from youth all the way up. Not to oversimplify the problem, but that’s the main driver as I see it.” (Orthopedic Surgeon #4)

In our interviews, programs focusing on maximizing velocity, including weighted ball programs, were among the most controversial and frequently cited contributors to injury risk by medical experts, though some experts suggested that these programs could be implemented in a way that improves performance while managing or mitigating injury risk.

“Weighted ball programs – the literature tells us they help people increase their velocity but there’s also a huge risk of injury involved with that. It’s the same with any athlete in any sport. People are going to do it if it makes them better, if they think it’ll help them make more money, get a better contract. What good is having really healthy pitchers if they can’t win at the big-league level?” (Major League Athletic Trainer #1)

“Velocity, that’s number 1. Another one is the weighted ball ordeal. It’s not a new thing. When I was playing, we threw the weighted balls we had. A baseball is 5 ounces, we had a 4 and 5 ounce ball. Now they have ridiculous 1 pound balls. I’m just not sure the arm can adapt to that. The weighted ball and trying to create whip with a heavy or light ball – you’re overdoing it. I think that has an effect.” (Orthopedic Surgeon #5)

“All the weighted ball training is a big issue. We had a significantly higher injury rate in people that use weighted balls. Is it the ball itself that creates injury? I’m not sure. We always saw guys that would take an abrupt bump in their velocity and those guys always tore their UCL. These guys are throwing too fast for what their body can handle. They’re getting paid to get guys out and their injury risk – performance trumps everything else. I don’t know how you stop that, though.” (Orthopedic Surgeon #6)



“My view is it has a place and it would be silly to say it doesn’t work. It works at increasing velocity. It also increases the risk of injury. That’s the reality.” (Biomechanist and Academic Researcher #2)

“My opinion on weighted balls has drastically changed. I’m not sure weighted balls in and of themselves are any riskier and can kind of be a scapegoat. In reality, it is probably just a piece of the puzzle. I wouldn’t be handing them out to 12- or 13-year-olds, but they are probably not the outright villain in the story as much as you may hear. At the pro level, lots of guys are throwing them, and how they use them is different. They’re a polarizing training tool if nothing else.” (Major League Physical Therapist #1)

“I am not a believer that plyo balls are a direct contributor to velocity. I believe they’re built for health, changing arm actions, to be in a healthier position and put yourself in a healthier spot. It’s a good activation tool. It can be used for other things. The drills will let guys put themselves in positions with deliveries they’re desiring, and they can go in front of a wall and work on opening their hip, t-spine mobility. Those are things we chase with the plyo ball program. To throw harder you’ve got to be able to have ranges in your movement pattern to throw harder.” (Major League Pitching Coach #1)

*b. “Stuff” and Pitch Design*

In addition to velocity, developments in baseball tracking technology, combined with the growing sophistication of data analysis, have resulted in Clubs and players attempting to optimize “stuff” – a term that describes composite movement characteristics of pitches including velocity, horizontal movement, vertical movement, and spin rate. Better “stuff” makes a pitch more difficult to hit. Like velocity, “stuff” is quantifiable and contemporary pitchers train to maximize it. The introduction of ball-tracking technology in the mid-2000s enabled professional players and Clubs to obtain data regarding pitch speed, trajectory, and location.<sup>11</sup> The emergence of more advanced and portable tracking technology since, and its growing availability, has also contributed to an increase in high intensity throwing practices, both outside of game activity and within games, by enabling the delivery of real-time pitch information to players and Clubs at scale.

“There’s also an aspect of the quantifiable components that go into the ingredients of a Major League pitcher. We can’t necessarily put our finger on this mindset or the sequencing of pitches this way, he’s operating this way, this is his routine in-between. But what we do get is his Statcast data and his pitch movement. Because it’s something we can see and track from a quantitative standpoint, it is a benchmark we can look after.” (MLB Club Pitching Development Executive #1)

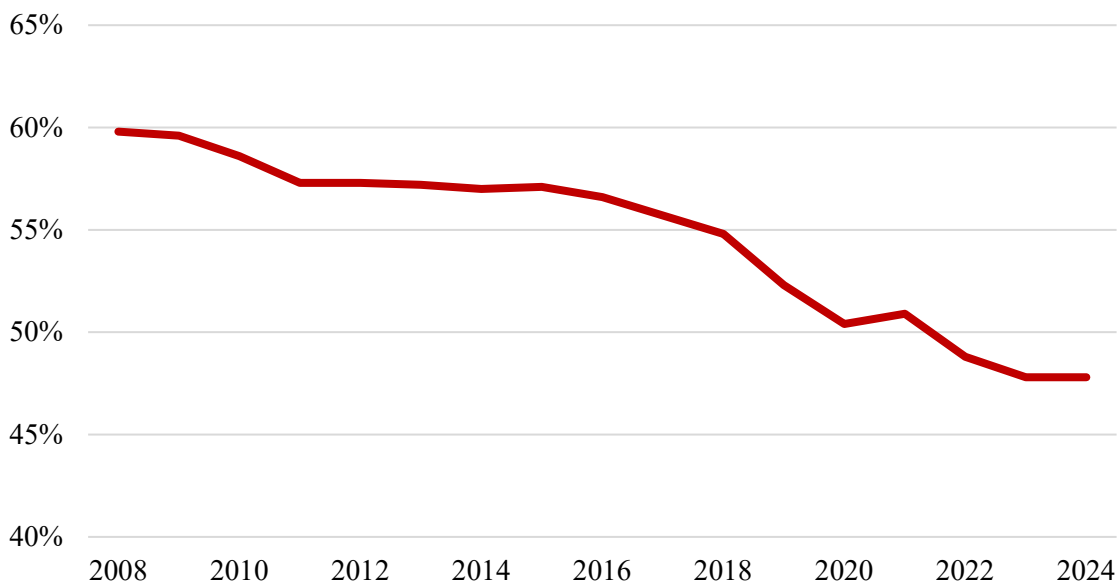
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<sup>11</sup> Fast M. What the Heck is PITCHf/x?. *The Hardball Times Baseball Annual* (2010).

“You must produce stuff. Nowadays to produce stuff, produce velocity, nasty breaking balls, you must throw more breaking balls because guys are trying to sit on heaters and people are training better and building better.” (Major League Pitching Coach #2)

“Stuff” has become increasingly prioritized by Clubs and players at the professional level. The pursuit of “stuff” has developed alongside the pursuit of velocity. Non-fastball usage – indicative of pitches that rely on “stuff” to generate swinging strikes or weak contact – has steadily climbed over the past two decades. Since 2008, fastball usage has declined from 60% of all pitches thrown in MLB to 48%. *See Figure 4.*

**Figure 4: Major League Fastball Usage, 2008-2024**



Clubs and players focus on pitch design that is intended to maximize “stuff.” Players maximize “stuff” by training to pitch using certain grips, release points, and deliveries that allow them to manipulate the ball’s trajectory. Although the specific injury impact of pitch design and training to optimize “stuff” is not currently well understood, medical experts speculated that pitch design training could contribute to injury risk by increasing stress on the arm. Training to pitch with unfamiliar grips or deliveries may be contrary to an individual pitcher’s natural biomechanics (sometimes referred to as movement or motor preferences) or may activate underutilized parts of the body that are inadequately trained to withstand increases in stress and volume.

“Just how we were always worried about players chasing velocity in the past, now there are a lot of other measures they can chase in terms of spin rate, spin efficiency, horizontal and vertical movement, more pitch manipulation in terms of how hard they’re holding the ball, where they’re holding the ball, and the percentage of

pitches they're throwing in their repertoire. Because now we have the technology to measure it, and we can take steps to outsmart other players. We're starting to see that those pitches are starting to contribute because the hands are working differently, which means the forearm is working differently, and the ligaments are working differently. They're starting to experiment a little bit more." (Orthopedic Surgeon #2)

"One of the big risk factors is not just the velocity of the fastball or the changeup, it's the change in mechanics to get higher spin. It's not just an increase in velocity, it's an increasing chase of spin rate. People are chasing spin and velocity, and I think they're changing their mechanics to chase this. If I were trying to run or swim or do something fast and I tried to run as hard as I could, it is going to get sloppy. The mechanics are broken down to chase this. If you're trying to get a certain velocity or spin rate, the change in mechanics is a mess. It's inconsistent and it's high stress." (Biomechanist and Academic Researcher #2)

Moreover, medical experts noted that pitch design training has become so prevalent that pitchers are materially increasing non-game intensity and volume in a manner likely to further increase stress on the arm. They theorized that the practice of pitch design, combined with the use of technology that provides rapid and immediate feedback, increases injury risk by reinforcing throwing intensity and preventing adequate rest and recovery. Moreover, accelerating the pitch learning process may not give the forearm, hand and other body parts adequate time to adapt to throwing at high intensities.

"Pitchers throw each pitch, and they look back at the data and that unfortunately leads to increased volume of throwing and increased intensity of throwing. You're chasing a number and you're chasing a metric. There's manipulation of the baseball and manipulation of mechanics within a throwing session. That's the most dangerous component of what's taking place here." (Major League Athletic Trainer #2)

"They're trying to get as much spin as possible. I mean, we have biomechanists behind the guys when they're throwing and they won't throw strikes but will ask what [their] spin rate is. Some of these pitches, like the sweeper, is a crazy pitch. It's kind of at an awkward angle for the arm and trying to snap the ball in a way the arm isn't used to." (Orthopedic Surgeon #5)

"After every pitch they're asking for horizontal movement, vertical movement. They'll throw a bullpen for 20 minutes and half the time they're just looking at the iPad." (Minor League Medical Coordinator #1)

Medical experts explained that some players are throwing pitches that may not come naturally to them and that may pose increased injury risk. Pitching development specialists emphasized the importance of understanding anatomical attributes and biomechanical markers

specific to individual pitchers and aligning them with ball flight objectives. Certain pitch types may be more biomechanically efficient for pitchers who are predisposed to releasing the ball supinated (*i.e.*, externally rotated or rotating the hand upwards) or pronated (*i.e.*, internally rotated or rotating the hand downwards). That pitch design may not always be implemented with movement preferences or predispositions in mind may lead to increased stress and injury risk. In modern pitch design, accounting for an individual’s motor preferences, or the natural movements of a pitcher, particularly with respect to their arm and hand at the point of ball release, is a developing area of focus with mixed adoption.

“Guys who are predisposed to releasing the ball a certain way – think about a guy who played football his whole life – he’s inclined to be around the ball, supinated. He’s probably stressing the musculature and everything under the hood, so the tissue load is far different from anything he’s ever handled in the past.” (MLB Club Pitching Development Executive #1)

“Guys are seeking out higher [induced vertical break] and carry on their fastball. They’re trying to force that instead of understanding what their motor preferences will allow. We focus on basing development off what the pitcher is already doing well.” (College Coach #1)

“I don’t think you can say a certain pitch like the sweeper or splitter is causing injuries. There’s too many other factors to say that a specific pitch is hurting guys elbows. However, you have to be careful and make sure that their body preference is to do certain things, make a pitch move a certain way.” (Major League Pitching Coach #3)

Many experts report that specific pitch types, particularly power off-speed pitches (*e.g.*, sliders and the increasingly popular “sweeper”), which are characterized by horizontal movement, may increase injury risk, though further research is needed on this topic. Additionally, pitches such as the splitter, which were once avoided due to their perceived injury risk, have surged in popularity because of their effectiveness.<sup>12</sup> The authors of a recent study based on pitch-tracking metrics and Injured List data reported that “the greatest predictors of future injury were increased pitch velocity (of all pitch types), utilization of sliders, fastball spin rate, and fastball horizontal movement.”<sup>13</sup> Orthopedic surgeons and biomechanical experts cited a combination of more forceful throwing motions and the grip required to generate the requisite pitch movement as mechanisms by which the forearm muscles are more rapidly fatigued, which exposes the UCL to increased forces.

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<sup>12</sup> Meisel Z, Stavenhagen C, Nesbitt S. Year of the Splitter? Once a Dark Art, the Pitch Is Primed to Take Over Baseball. *The Athletic* (2024).

<sup>13</sup> Oeding JF, Boos AM, Kalk JR, Sorenson D, Verhooven FM, Moatshe G, Camp CL. Pitch-Tracking Metrics as a Predictor of Future Shoulder and Elbow Injuries in Major League Baseball Pitchers: A Machine-Learning and Game-Theory Based Analysis. *Orthopaedic Journal of Sports Medicine* (2024).

“To me, it’s horizontal ball movement. And to create horizontal ball movement, you have to grip the crap out of the baseball and then cut it – either pronate it hard or supinate it hard with a very firm grip – and it’s causing this what we call eccentric load on muscles on the inner side of the elbow and then everywhere up the kinetic chain, meaning the lat and teres, which we’re seeing a huge number of tears in now that we hadn’t seen before, plus shoulder capsular tears. So, I think they are all a consequence of this change in pitch design.” (Orthopedic Surgeon #1)

“There’s an increase in these other pitch types that aren’t changeups – they’re ball spin [itches]. That leads to more stress on the elbow. Statistically, throwing a spinning pitch doesn’t specifically put more stress on the UCL. But, because you’re generating spin, the muscles that do that are the same ones that protect the UCL. If they fatigue, you’re creating a problem.” (Orthopedic Surgeon #7)

Experts noted one reason it has been difficult to study the relative injury risk of certain pitch types is that different grips or biomechanical actions between pitchers may not fully explain the movement profiles of pitches. In other words, there are other factors that impact the baseball flight path that may not increase risk of injury, such as the orientation of the ball. For example, throwing a fastball using a two-seam grip may result in a different pitch movement profile than throwing a fastball using a four-seam grip – but this change in ball orientation by itself is unlikely to correlate with a significantly different risk of injury between the two pitches.

### *c. Max-Effort Throwing*

In addition to “stuff” and velocity, industry experts also identified an increase in pitchers throwing at or near maximum effort during games and training sessions as contributing to injury risk. They believe that, despite pitchers throwing fewer total pitches during games than in past years, overall throwing intensity and workload has surged in recent years, particularly when factoring in all activity throughout the course of the year. In other words, pitchers are not only pitching with *higher* velocity, they are throwing at or near their *maximum* velocity more than ever before. See Figure 5.

**Figure 5: Average Standard Deviation of Velocity and Spin Rate by Pitch Type, 2017-2024 (All Pitchers, Minimum 10 Appearances)**

Year	Average SD of Velocity				Average SD of Spin-Rate	
	4-Seam FB	Curveball	Slider	Change	Curveball	Slider
2017	1.18	1.43	1.50	1.35	121.3	162.4
2018	1.17	1.42	1.45	1.30	120.9	146.6
2019	1.12	1.43	1.44	1.26	121.3	146.4
2020	1.04	1.33	1.35	1.18	142.1	156.8
2021	1.14	1.42	1.44	1.27	122.6	119.4
2022	1.10	1.38	1.41	1.25	112.9	109.7
2023	1.08	1.35	1.35	1.26	107.5	100.3
2024	1.09	1.33	1.38	1.22	110.7	105.7
<b>'17-'24 Delta</b>	<b>-0.09</b>	<b>-0.10</b>	<b>-0.12</b>	<b>-0.13</b>	<b>-10.6</b>	<b>-56.7</b>

Pitchers increasingly throw near maximum effort in accordance with modern baseball strategies that prioritize the pursuit of swings and misses over inducing weak contact from batters. *See* Section IV.A, *infra*. Moreover, industry experts explained that modern workload management strategies – ostensibly intended to prevent overuse, protect pitcher health, and maximize pitcher effectiveness – may actually increase injury risk by allowing and even incentivizing pitchers to throw with maximum effort on every pitch, rather than requiring pitchers to conserve energy and pace themselves in an effort to pitch through longer outings.

“I was never max effort . . . we were taught to throw what was comfortable. I was comfortable at 94. I could throw 98, 99, but I never grunted. I had extra when I wanted to; I had stuff I could do in reserve.” (Former Major League Pitcher #1)

“I used to pitch to chase outs. Now they chase velocity. I had to play a chess match to try to get 24 or 27 outs. Now it’s a sprint to go as hard as you can, as long as you can. Starters have a reliever’s mentality now. I never went on the IL in 10+ years, and I’m not superhuman. But two things worked in my favor. Over the course of a game, I would throw 6-10 pitches as fast as I could . . . people like Nolan [Ryan] are superhuman, but the rest of us had to play cat-and-mouse to get through the lineup three or four times.” (Former Major League Pitcher #2)

“There was never anything about max intent when I was playing. It wasn’t even there. Now, we’re playing catch at max intent, plyo balls at max intent. [Kids are] swinging at max intent, falling down, and hitting [themselves] in the back. In the big leagues, that’s the word right now. When you get paid [for it] – I get it. In college, it’s max effort all the time. It’s scary. What’s the one reason this stuff is

happening? The max effort. But, it gets you paid; it gets you scholarships [and] success.” (Former Major League Pitcher #3)

“Let’s say 20% [of pitches] were as hard as I could. Once I got into a strikeout situation, I’m just trying to put you away and get up on it a little better. If you didn’t get to three times around the order, if you didn’t get to the 8th inning, you shouldn’t expect a win. Nowadays you know you’re only going to the 5th inning, and you start throwing as hard as you can.” (Former Major League Pitcher #4)

“If he goes 60 or 70 pitches, he’s going to sit 100. He’s not stupid. And if we tell him, ‘There’s no limits on you,’ but we keep taking him out after 70 pitches every time, he’s going to realize what’s going on. If he can’t control the volume, the one lever he can control is the intensity. I personally think that’s worse for his arm, going max effort for shorter stints . . . that’s the question I think people aren’t ready to answer. They think that limiting the players is at least, at worst, neutral. And my argument is (that) I don’t think you know that. I think there’s a possibility you’re actually making them more likely to get hurt.” (Kyle Boddy, as quoted in *Baseball America*)<sup>14</sup>

Industry experts speculated that the greater availability of pitching information has contributed to increases in max-effort throwing because more activities – including non-game appearances, such as bullpen sessions – are closely dissected. Information gleaned from modern pitch tracking and motion capture technology is used to evaluate performance, regardless of game or non-game activity. Club officials and former pitchers explained that deviations from baselines in advanced pitching metrics are increasingly scrutinized, resulting in pitchers chasing max-effort performance even in non-game settings, and leading to greater injury risk.

“In the past, just talking about starters, they threw one pen. Most threw one, some threw two. It was just a touch and feel, get through their delivery, get their arm warmed-up, spin a few balls. Maybe they’re working on something, but they weren’t maxing out. Maybe 75%. The pitcher, pitching coach, trainer, you’d go through it in eight minutes. Now every pitch thrown on the side, they’re running Rapsodo. They have their pitch design guy, they’re tracking your stuff score on your sweeper. The score was at 90% effort but if you throw it harder and finish it, you’ll get close to 100% efficiency with it, so let’s use this side session to work on that. And then you’re ripping sliders for fifteen minutes.” (Front Office Executive #1)

“With all the Rapsodo things on pitchers from day one in spring training, it’s very hard to not go close to 100%. So, when you increase your effort level, more often than not you’re going to put more strain. Now, you have the added element of

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<sup>14</sup> Cooper J. Dramatically Scaling Back Young Pitchers’ Workloads Has Not Kept Them Healthier. *Baseball America* (2024).

cameras analyzing everything you do. They're tracking everything you do. It's human nature to put your best foot forward." (Former Major League Pitcher #5)

"With all the modeling of pitches that goes on now, it's very binary that higher velocity with a better shape is going to yield more positive outcomes. It's hard for guys to step off the gas because it's me versus you, and if I'm going to give less than my best effort, and if you hit it over the fence, I'll be kicking myself because I know I could've done more." (MLB Club Pitching Development Executive #1)

"They'll turn around and look at the Edgertronic and TrackMan, and they're married to it. And they'll ask where was that? Am I tunneling? I think it's deadly. You're challenging them on the mound to grip it, rip it. They come in and are asking what's my carry?" (Major League Athletic Trainer #3)

"The pitcher gets a report at the end of each game: average [velocity], range of [velocity], spin efficiency, [induced vertical break] across a period of time, etc. If I'm the pitcher, I know a Club values this because they send this in an email to me. What do I have to do if I want to stay in the rotation? For [induced vertical break] I must get behind my fastball. I need to increase [fastball velocity] because the computer says that will help how my secondaries play. My fastball is below the league average, therefore I'll be instructed to go [to a facility in the offseason]." (Former Major League Pitcher #6)

Industry experts theorized that modern pitchers may be more susceptible to injury because of the relative de-emphasis on other training modalities in recent years. They pointed to the anecdotal decline in cardiovascular and endurance training for pitchers, which was more prevalent in prior generations, in favor of the power- and strength-focused training that is more commonly prescribed in the contemporary game. They believe that the prioritization of training short-burst power over durability contributes to injury risk.

"There used to be starting pitchers doing endurance runs, and now we're in the power, short-burst, sprint-type training, and that's changed . . . It's okay to train for sudden bursts of power and what I'd call anaerobic training. I always tell people that's fine, but you need a basis of aerobic capacity to do that. You have to have that endurance, aerobic capacity in your heart and lungs before you start training like that. That's the problem we have. We do too much of this heavy lifting, short-burst power. That's where I think we're missing it." (Major League Athletic Trainer #1)

"Now guys are implementing plyo balls and different types of throwing with weighted balls just to try and increase velocity. For me increasing velocity was just getting stronger, running, and long toss. There are faster ways to build that up now and I think some stuff is actually good, but I also think that could be leading to



injuries, especially if people are doing it the wrong way.” (Former Major League Pitcher #7)

“That is really the velocity arms race, and they’re recognizing that in order to stay at the top, they have to do a lot of extra work. I divide it into in-season workload and out-of-season workload. In-season, they’re spending more time in the weight room trying to get bigger, stronger, lifting and throwing heavy plyo balls, and doing wall tosses to maintain those high levels of velocity . . . They’re all well intentioned to improve performance but some of those things are probably increasing injury risk as they’re improving performance.” (Orthopedic Surgeon #2)

“If I had to look at the overall landscape of pitching, guys pitch too much and don’t throw enough. There’s not enough adaptation with promotion to each level of play. Guys think they’re making up for it with weight and resistance training. In the weight room, a focus on absolute instead of functional strength is a bigger cause. Players are getting stronger, but it’s not functional strength and doesn’t help.” (Independent Pitching Development Coach #2)

Multiple medical experts described new injury patterns that they believe are tied to the focus on velocity and max-effort pitching. These injuries (such as latissimus and teres major tears, rib fractures, and oblique strains) appear to be more acute than chronic in nature and are representative of the body’s inability to withstand bursts of intensity, rather than gradual wear-and-tear.

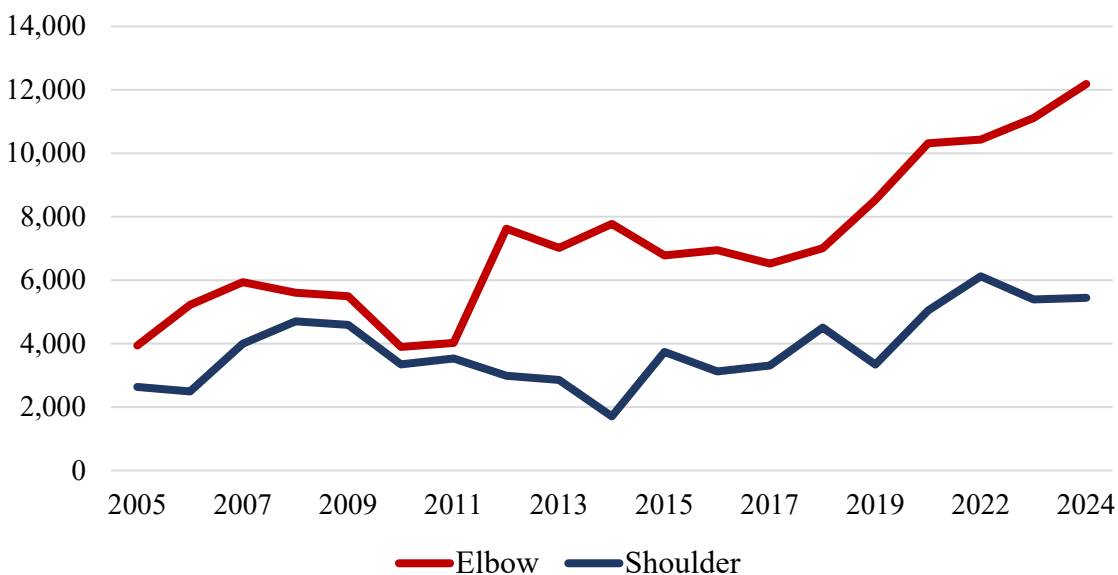
“When you look at the shoulder, you see more lat teres major, subscap, capsule injuries – I’ve seen more in the last 5 years than I saw in the prior 25. I think that’s true. I don’t have numbers but in my business we – maybe we missed the diagnoses but MRIs have been around a long time and we just didn’t see those injuries. But they have a common theme. They all are under maximum duress at the change from external to internal rotation. The capsule’s under maximum violent stretch and those muscles are the exact ones that would be trying to protect the capsule at that instance. I’m not kidding you. For 20 years, I don’t think I saw more than 1 or 2. Now in the last 5 years, those muscles that are all synchronized for a specific part of the pitching motion – now I’m seeing a couple a year on the 26-man roster alone. It’s different.” (Orthopedic Surgeon #8)

“We saw those chronic injuries twenty years ago, that’s why we used to see shoulder injuries. We saw Tommy John surgeries in players that were at the end of their careers when they started to have it. Now, we’re seeing these injuries in players in their early twenties. What’s more alarming to me, is you can classify chunks of injuries differently. This is just an estimate, but it used to be 80 percent to 20 percent chronic to acute, now it’s maybe flipped. Some of the injuries are absurd. Sub-scap tears, lat tears, rib fractures . . . you know how hard it is to fracture a rib throwing a baseball? Now you have a lat that’s ripping off the bone. Part of that is

the younger kids have more mileage, but also it’s the aggressiveness.” (Major League Physical Therapist #2)

Medical experts also expressed concern over the recent increase in shoulder injuries. While IL days attributable to elbow injuries have steadily increased over the last 20 years, IL days attributable to shoulder injuries were relatively flat until the last three years. Experts theorized that velocity gains over time have offset improvements in preventative shoulder strengthening programs and that velocity programs may add velocity but also increase shoulder range of motion in a manner that increases shoulder injury risk. See Figure 6.

**Figure 6: Pitcher IL Days, Elbow and Shoulder Only, 2005-2024<sup>†</sup>**

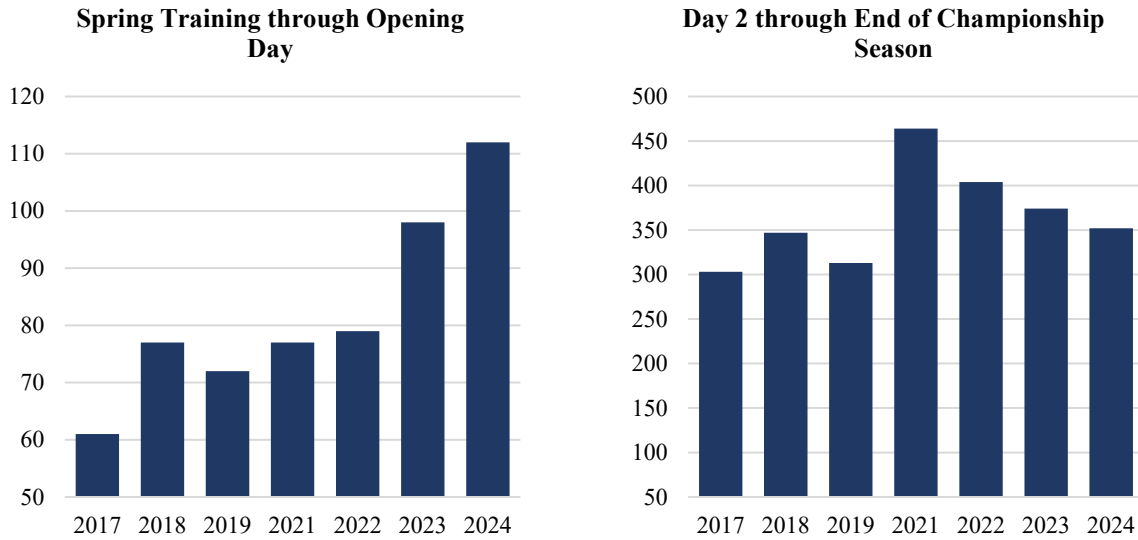


*d. Off-Season and Early Season Workload*

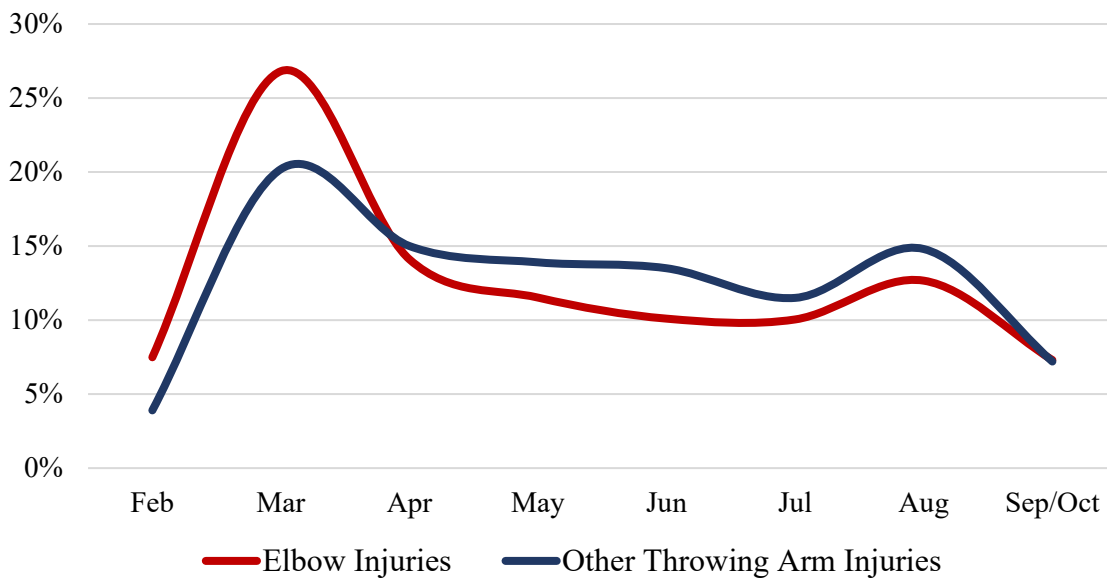
Some of the most significant pitching and training changes over the last ten years have occurred outside of the regular season. Pointing to the increase in Spring Training and early season injuries, many experts suggested that higher-intensity offseason throwing programs and a lack of consensus regarding the optimal Spring Training workload potentially contribute to pitcher injury risk. See Figures 7, 8.

<sup>†</sup> Excludes 2020 season

**Figure 7: Pitcher IL Placements Through Opening Day Compared to In-Season IL Placements, 2017-2024<sup>†</sup>**



**Figure 8: Average Pitcher IL Placements by Month, 2010-2024<sup>†</sup>**



<sup>†</sup> Excludes 2020 season

Medical experts agreed that offseason interventions, particularly those focused on max effort throwing or the pursuit of rapid increases in velocity, are more likely to result in increased injury risk. When intensive training methods are implemented during the offseason, the arm has less time to rest and recover from the previous season. Moreover, because private facilities utilized by pitchers in the offseason have a limited window to achieve measurable results, biomechanical changes are accelerated rather than gradually integrated, also potentially leading to higher injury risk.

“We go from [the] season ending to offseason programs because we want to add velocity or a breaking ball. They don’t get any time off. They want to start spinning the ball and they’re never giving the arm a break.” (Former Major League Pitcher #8)

“Out-of-season, they’re doing things, so now we’re seeing them very commonly go to performance centers who have a shortened timeline. They only have the guy a month or two, and they have to clearly demonstrate some added objective value by increasing their velocity by this amount. There’s a short window to make measurable differences, which can cause stress.” (Orthopedic Surgeon #2)

“You’re throwing a full intensity bullpen in late December and January when you normally wouldn’t have done that until late February. The overall volume and intensity of throwing has increased a great deal. If a pitcher comes into camp at a much higher velo than they were throwing last year – we’re mindful of how much they’re throwing. We’ll decrease the number of pitches they throw. That’s driven from the medical staff. When the organization sees a spike in velocity they’re giving high fives, but I’m really concerned for those players.” (Major League Athletic Trainer #2)

“Historically speaking, it was 8 to 10 bullpens or fewer coming into camp, then rolling right into live batting practice and games. When doing this, the ramp-up period is pretty steep. Modern expectations have been based in more bullpens. 15 to 18 bullpens before facing hitters and facing live BP.” (Major League Physical Therapist #1)

“Kids know how they’re getting paid. They’re getting paid on stuff. The season’s long, and when it ends, they’re going to camp. And it’s December. And they’re throwing slider after slider trying to get the right grip. You can’t tell me that doesn’t affect them. I don’t think guys ripping slider after slider in January – there has to be some impact to that.” (Front Office Executive #2)

“When is the time for pitch design and time to tinker? The offseason. They say in golf that you practice on the range and you play on the course. You can’t try new swings on the course. In the season, your slider is your slider unless the anatomy

of that pitch really takes a dive. But during the offseason, if you're not designing and refining, then guys are passing you by." (Former Major League Pitcher #9)

"This confusion of why the offseason is now dangerous – to me, the offseason is a luxury for professional players and you can use the offseason to prepare for next season and get better. You have 7 to 8 months during the season, then you can take a period to rest and de-load. Then you have 12 weeks to build up to the point that you can be stronger and more durable for the next season. The problem comes from players not having a down period and doing a lot of high intent throwing and not managing the delta – shocking the arm unnecessarily." (Independent Pitching Development Coach #3)

"It used to be a longer offseason. Guys didn't go to performance centers. The black sheep would play catch. Guys would lift and play catch, and they'd throw mid-December at the earliest . . . You don't want laxity, you want to keep the tension. But now, when you go online you see guys throwing at [third-party training facilities]. That's what didn't exist." (Major League Athletic Trainer #3)

"I'm not against playing catch in the offseason. On the medical side [the way players train in the offseason is] the dumbest thing I've ever seen. It's the lowest hanging fruit. We talk about all these things on the medical side – proper mechanics – and then you watch what happens there and it's like caveman stuff. Take a big rock and throw it as hard as you can." (Major League Athletic Trainer #4)

Players and coaches typically are hesitant to make significant changes during the season. One of the reasons for this reluctance is a concern that pitching adjustments during the season may increase the likelihood of an injury or impact performance. But, pitching adjustments during the offseason (and the training load associated with those changes) do not necessarily reduce injury risk, and may in fact contribute to early season injury trends.

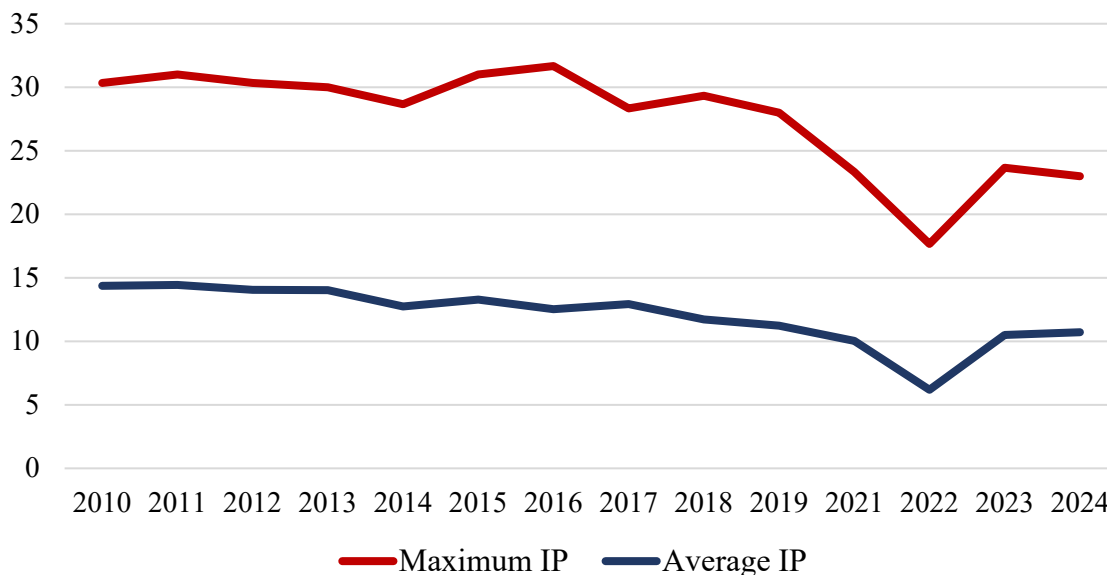
"We try not to let a lot of our guys [make grip or pitch type adjustments] in-season. We have a guy, one of our more successful pitchers. His grip was hurting his hand and he kind of had a soreness in his hand in this area and he wanted to move it to these two fingers, and this was late in the season. And we asked him not to do that and discouraged the pitching department from doing that. We didn't want him to do it in the season. He'll work on that during the offseason to move that changeup over when he can do it gradually over the course of several months." (Major League Athletic Trainer #1)

"Now that Hawkeye is usable and informative, we have a lot more conversations around 'this player was better with kinematics XYZ, and we want them to be better' so we use the bullpen to actually pursue those changes. But actively changing mechanics adds to injury risk, especially in the middle of the season. There's an

interesting discussion to be had around changing mechanics in season for performance versus injury risk.” (Major League Athletic Trainer #5)

Additionally, some experts believed that Clubs are not optimizing pitchers’ Spring Training usage. There has been a recent trend of Clubs being more conservative with pitcher workloads during Spring Training, presumably to reduce the likelihood of player injuries as they ramp up for the regular season. *See* Figure 9. Although well-intentioned, this trend of reduced Spring Training workloads has coincided with an increase in early-season and Spring Training injuries, which contributes to the conclusion of some experts that pitchers are exposed to a higher risk of injury because they are not prepared for the dramatic increase in workload and intensity when the season begins.

**Figure 9: Spring Training Workload, Pitchers on Opening Day Rosters<sup>†</sup>**



There currently is no consensus on the best time of the year to pursue pitching changes or the best way to manage offseason training or Spring Training workloads. Pitcher offseason programs remain highly individualized and vary based on role, recent performance, and injury history—though there is broad consensus that these programs have increased in intensity in recent years. Closers may train differently than starters and more established stars may train differently than fringe roster players. Even among the experts who believe max effort throwing or the pursuit of rapid increases in velocity contribute to increased injury risk, there are mixed opinions on the best regimens to prevent injuries. Given the lack of consensus, medical experts identified offseason training regimens and Spring Training usage as important areas on which to focus additional research.

<sup>†</sup> Excludes 2020 season

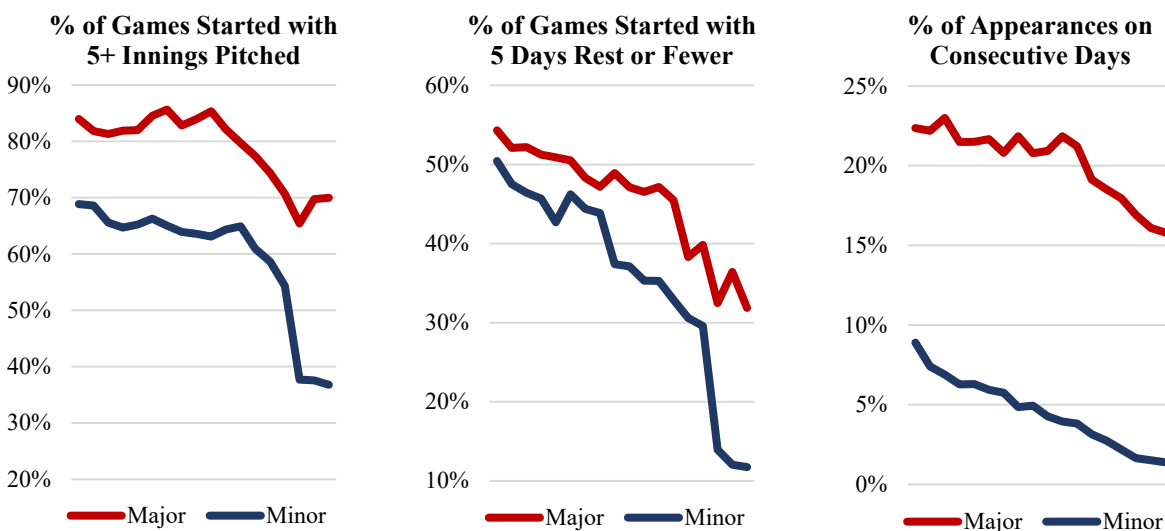
## 2. Other Potential Factors

Although the prevailing consensus among experts is that the current focus on velocity, “stuff,” and max-effort throwing are the leading culprits of pitcher injuries, certain experts and stakeholders identified a number of other factors that may warrant further research. These include the failure to appropriately prepare Minor League players for Major League workloads, an individual player’s own history of past injury, playing rule changes designed to improve pace of play, the characteristics of the baseball including the pitcher’s ability to grip the ball, the lasting impact of the COVID-19 pandemic, and Club organizational dynamics and staffing changes.

### *a. Minor League Player Development & Workload Management Practices*

Club representatives noted that certain workload management practices, which are intended to keep players healthy, may have unintended effects on player health. In this respect, there is a perceived trend of Minor League players being underprepared to handle Major League workloads. Experts view certain workload management practices in the Minor Leagues – which include innings limits and more rest between appearances for starters, or restrictions on relievers pitching back-to-back days or appearing three times in four days – as failing to adequately expose pitchers to the demands of the Major League season. See Figure 10.

**Figure 10: Differences in Major and Minor League Pitcher Usage, 2005-2024<sup>†</sup>**



This may deprive young pitchers of the opportunity to learn and develop the durability required to be healthy and successful at the Major League level, according to some experts. Club

<sup>†</sup> Excludes 2020 season

officials also expressed challenges with balancing pitcher development objectives with the necessity of maintaining depth for the Major League team.

“Until he gets to the big leagues, they need to manage him and keep him healthy. You don’t want a guy using up all his bullets in the Minor Leagues and then getting hurt when he gets to the Major Leagues. It’s the bullet theory. You also want him to build a big chamber to sustain that in the Major Leagues. I think guys are coddled too much in the whole industry – in the Minor Leagues and when they get to the majors. They’re not ready for a game in Yankee Stadium on a Friday night. But having said that, they need to be healthy to get there too.” (Major League Athletic Trainer #1)

“When do you throw your first back-to-back? It’s in the Major Leagues. Same with three out of four days. They’re not getting exposed to it in the Minor Leagues. That’s a lot of strain on your arm, if you’re not accustomed to monitoring your warm-up pitches in the bullpen and used to the recovery afterwards to prepare yourself for the next day. Physically, it’s a lot more demanding.” (Former Major League Pitcher #5)

“In trying not to break young arms, you’re doing them a disservice. A phenom will come up and you’re putting him into a five-man rotation, whereas in the minors he pitched every sixth day, and he’s never thrown more than 75 innings in the minors, and now he’s going to go 125? My last game in college, I threw 190 pitches. That’s not good either. But at some point, you’ve got to pitch back-to-back, you’ve got to throw a lot of pitches or innings, and if you don’t do that until you’re facing Mookie Betts, you’re going to put a lot of strain on your arm. So you’ve got to train these guys for marathons and not sprints.” (Former Major League Pitcher #2)

Many former pitchers and pitching development experts pointed to their desire for a philosophical shift away from such strict practices to a more thoughtful approach to preparing players for heavier workloads over time.

“We have to shift our mindset. You talk to a younger pitcher and they say that they aren’t ready to push themselves because they haven’t done it in the Minor Leagues. We’ve got to build horses. We’re going in the wrong direction.” (Major League Pitching Coach #3)

“Up to this point, the process has been to limit workload. Make sure they don’t throw too much or with too much intensity. Instead of limiting workload, we have to do really good conditioning and preparation for tolerating stresses on the arm. Let’s focus our attention on conditioning and training, and gradually building up the resilience and robustness of the tissue so that we can tolerate the stress that happens inevitably. It comes down to ‘only so many bullets in the gun’ or ‘how do you load the weapon.’” (Independent Pitching Development Coach #4)



“We need to empower the athlete, let the athlete adapt to their own self-regulation. Athletes know how best to condition themselves to listen to their own bodies, but we have sucked the intuition and instincts out of athletes. We are telling athletes ‘we know your body better than you, your elbow better than you, how many throws you should make more than you.’ We’re managing the arm more than ever before, yet injuries continue to go up.” (Independent Pitching Development Coach #5)

These views are in tension with the increasingly conservative handling of Major League and Minor League pitchers, and there is still widely varying opinions on the best way to develop pitchers for the rigors of a Major League workload. Further study is needed to evaluate workload management practices that balance the need to expose developing pitchers to heightened workloads with the current propensity to emphasize rest and recovery.

#### *b. Prior Injury History*

Research indicates that a pitcher’s prior injury history is a significant predictor of future injury. As the number of pitcher injuries continues to rise – and as pitchers get injured at younger ages – larger swaths of the player population become more predisposed to injury in the future. *See* Figures 11, 12.

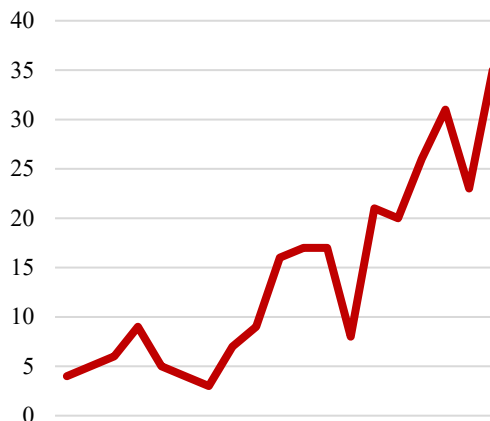
“There’s a lot of damage done by the time they get to our campus. Not to blame somebody else, but guys we get are either damaged or on their way to stressing their ligaments because of what they go through in travel ball . . . they throw as hard as they can on Saturday, do nothing Sunday through Friday, and then throw as hard as they can next Saturday. They’re doing irreversible damage. It’s happening as young as 12 years old up until they come to our college program.” (College Coach #2)

“We’re getting guys now out of the draft that have been throwing year-round – our first-round guy had been throwing year round for 3 years. The wear and tear on him isn’t going to be his first Major League season, it’s going to be from those previous 3 years. That’s where the wear and tear is from. Now they’re in the Minor League season, and they’re doing more than they’ve ever done.” (Major League Athletic Trainer #6)

**Figure 11: % of Opening Day Rosters with IL Time in Previous Season (2005-2024)**



**Figure 12: Players Drafted in Top Ten Rounds with History of UCL Surgeries (2005-2024)<sup>†</sup>**



One recent study reviewed elbow MRIs from top draft prospects from 2011-2017 and found abnormalities for 70% of pitchers, most commonly involving the UCL, though the authors recommended additional research to better understand whether these findings were normal adaptive changes for a throwing athlete or indicative of future injury risk.<sup>15</sup>

Efforts by MLB and the MLBPA to establish procedures for centralized pre-Draft medical review of pitchers may facilitate further research on this issue. Beginning in 2017, MLB and the MLBPA established a central pre-Draft MRI program for select pitchers, creating the first program to collect standardized medical information for top players eligible for the First-Year Player Draft (otherwise known as the Draft, the Amateur Draft or Rule 4 Draft). In 2022, MLB and the MLBPA expanded on that program and implemented a scouting and medical Combine, including an incentive-based program for top players to undergo comprehensive medical evaluations at a centralized location in the weeks prior to the Draft. This medical evaluation includes medical history screens, MRIs, x-rays, sports cardiology testing, labs, and an orthopedic and general medical exam. The continuing collection of data in this area should lead to a better understanding of the relevance of prior injuries (and injuries sustained in amateur baseball) to the risks of future injuries, and support initiatives to help prevent repeat occurrences.<sup>16</sup>

As players start pitching at younger ages they are also suffering injuries at younger ages, and are therefore more likely to suffer a reinjury at some point in the future. One of the byproducts of pitchers getting injured at younger ages is that they are now having multiple UCL injuries. In

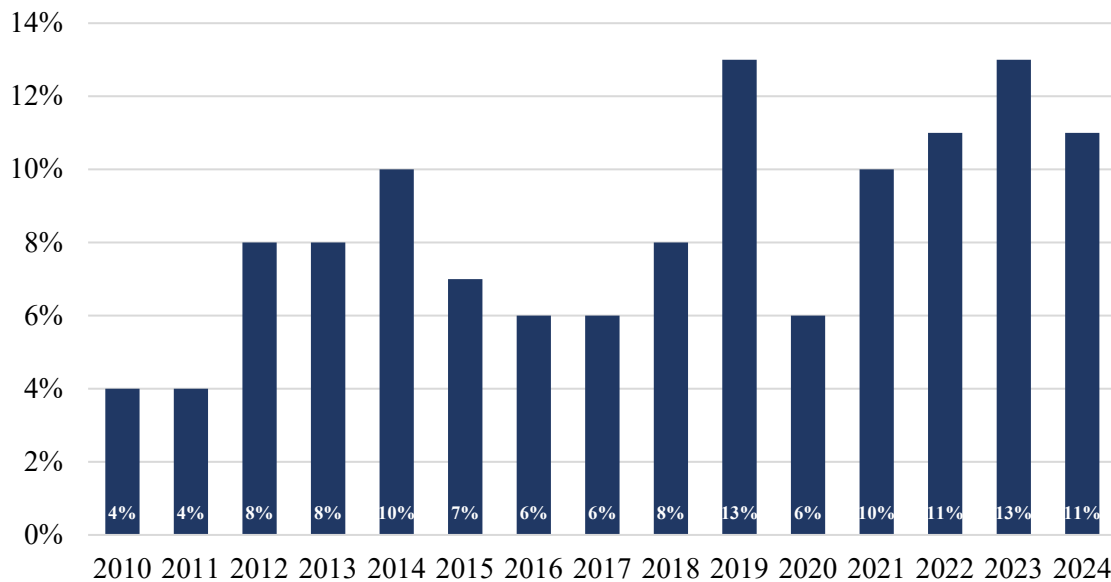
<sup>†</sup> Excludes 2020 season

<sup>15</sup> Erickson BJ, Chalmers PN, D'Angelo J, Ma K, Fealy S, Alexander F, Ahmad CS. Predraft Elbow Magnetic Resonance Imaging in Major League Baseball Pitchers. *Journal of Shoulder and Elbow Surgery* (2024).

<sup>16</sup> Erickson BJ, Chalmers PN, et al. Shoulder and Elbow Pathology of the Major League Baseball Combine: A Description of the "Normal" Prospective Professional Baseball Player (Unpublished).

fact, second or subsequent UCL surgeries (known as revision UCL surgeries) have increased over time. *See* Figure 13. This is particularly concerning because the success rate for revision UCL surgeries is lower than for primary UCL surgeries. Recent academic research reported that following UCL revision, only 72% of professional baseball pitchers were able to return to play at any level, and only 59% were able to return to the same level of play.<sup>17</sup>

**Figure 13: % of Revision UCL Surgeries in Professional Baseball, 2010-2024**



### *c. Rule Changes*

Some public commentary has speculated that recent rule changes, including the introduction of the pitch clock in 2023, has resulted in increased risk of injury. Current data has not demonstrated a correlation between the introduction of the pitch clock and injury risk. A recent independent study, which is currently under peer review for publication, analyzed injury and pace-of-game data from the 2022 season (which did not have a pitch clock in the Major Leagues) and the 2023 season (the first year that the pitch clock was used in the Major Leagues) and concluded that on average, pitchers who worked quickly were no more likely to sustain an injury than those who worked less quickly.<sup>18</sup> Additionally, on average, pitchers who sped up their pace of pitching between the 2022 and 2023 seasons were no more likely to sustain an injury than those who did

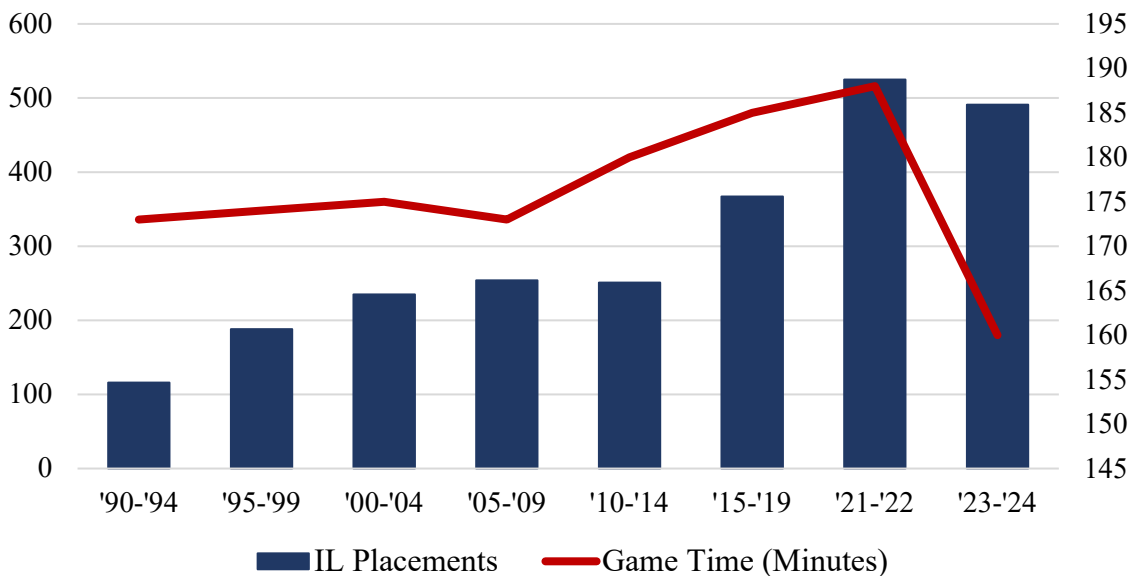
<sup>17</sup> Erickson BJ, Camp CL, Chalmers PN, Griffith TB, Simon KN, Hebert E, Meister K. Outcomes of Revision Elbow Medial Ulnar Collateral Ligament Reconstruction in Professional Baseball Players: An Analysis of 191 Pitchers from 2010 to 2023 (Unpublished).

<sup>18</sup> Fleisig GS, Hebert E, Wheatley S, Chalmers PN, Erickson BJ, Casey H, D'Angelo J, Curriero FC. Has the Pitch Timer Rule in Major League Baseball Affected the Incidence Rate of Pitching Injuries? (Unpublished).

not. In our interviews for this paper, medical experts also overwhelmingly rejected the hypothesis that the pitch clock has been a primary driver of injuries in the short-term.

Furthermore, a comparison of the available injury data from the 2023 and 2024 seasons to the decades-long trend in increasing injuries, suggests that the pitch clock has *not* resulted in increased injury risk. Injured List days for pitchers have steadily climbed since the 1990s, even though pace of play slowed during that time. In other words, there actually is a strong correlation between the growing instances of pitcher injuries and a slower or reduced pace of play *before* the introduction of the pitch clock. *See* Figure 14. Industry experts also suggest that the slower pace of play in more recent years may be related to max-effort pitching, further supporting the link between a slower game and higher injury risk. Finally, interviewees pointed to the seasonality of Injured List placements in 2023 to illustrate the lack of an effect from the pitch clock. Injured List placements were lower in every month from May through the end of the season compared to 2022, and there was no identifiable increase in IL placements as the 2023 season progressed. And total pitcher Injured List placements reached a three-year low in 2024. Notwithstanding the foregoing, we recommend continuing to monitor this issue and review whether there is any additional evidence to support this theory over time.

**Figure 14: Major League Pitcher IL Placements and Average Game Time, 1990-2024<sup>†</sup>**



*d. Grip and Spin*

Some interviewees described that modern pitchers who chase high spin rates and extreme pitch movement profiles do so by gripping and spinning the baseball with greater force. Some theorize that recent enforcement of the prohibition on foreign substances has resulted in pitchers compensating by gripping the ball more tightly and spinning it harder to generate better pitch

<sup>†</sup> Excludes 2020 season

movement. They explained that the extra effort exerted to grip and spin the ball at higher forces results in more rapid fatigue, taxing the underlying musculature of the hands and forearm. Multiple experts pointed out that efforts to improve grip may have unclear impacts on injury risk; the current focus on maximizing spin and pitch movement may permit pitchers to push the limits in these areas, even with improvements to grip.

A connection between grip and pitching injuries is not well described in the academic literature. One recent study attempting to examine the relationship in a population of professional pitchers found no significant difference in mean grip strength over the course of a season between pitchers who did and did not sustain elbow injuries. The authors noted that further medical research is needed to determine whether grip strength over the course of a game is correlated with injury.<sup>19</sup> But conclusive research in this area will be challenging. Unlike velocity or spin, grip on the baseball—particularly in-game—is not easily measured by existing ball- or player-tracking data; rather, current attempts to study grip and related injuries to date have relied on proxies for grip measured outside of game activity. Accordingly, absent the development of baseball-specific grip measurement technology, conclusions about the effect of grip on player injuries is likely to remain mostly theoretical.

#### *e. COVID-19*

The impacts of the COVID-19 shortened 2020 season (including the interruptions to the traditional training calendar, subsequent ramp-up for an abridged season, fewer opportunities and innings to pitch during the abridged Major League season and cancelled Minor League and abridged or cancelled amateur seasons) are not well understood. Experts suggested that it is likely that these abridged seasons and unusual training routines had at least some effect on future player health, as injury rates in MLB and the Minor Leagues spiked in 2021 and have continued to track above pre-COVID rates in 2022, 2023 and 2024. Additional research is necessary to better understand whether or to what extent abridged professional and amateur seasons resulting from COVID-19 had on long-term injury rates for pitchers.

#### *f. Organizational Challenges*

Club officials described organizational factors as potentially complicating efforts to combat the rise in pitcher injuries. Clubs have dedicated resources to injury research and prevention. However, Clubs experience turnover in front office and medical personnel, which can interrupt efforts to implement long-term pitching and health initiatives. Club officials described competing pressures between the short-term desire to maximize player performance and the potential long-term consequences of consistently striving to do so. For example, there is a potential moral hazard inherent in accelerating the development of young pitching prospects so that they may more quickly contribute to the Major League Club (including by asking pitchers to throw high-risk, maxed-out pitches in the present), knowing that any associated injury cost will be borne in the

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<sup>19</sup> Erickson BJ, Buchheit P, Rauch J, Ciccotti MG, Paul RW, Cohen SB. Is There a Relationship Between Grip Strength and Injuries in Professional Baseball Players? *Orthopaedic Journal of Sports Medicine* (2024).

longer term. Having said that, the potential conflict of interest has not necessarily been borne out by actual experience – there are numerous examples of Club officials sitting their best young stars during a pennant race in the perceived best interest of the pitcher’s long-term health (and not in that Club executive’s short-term interests).

Compounding the issue is the simple fact that injuries continue to accumulate, even though the sizes of front offices, coaching staffs, and medical staffs have increased in recent years. Some Club officials believe that growth in the sizes of front offices, coaching staffs, and medical staffs have increased the challenge of communication across different organizational groups. The increased specializations of each of the growing departments has resulted in challenges in coordinating medical care and pitching plans across player development at each level of the Minor Leagues and the Major Leagues. Although it may be true that improvements in medical care, larger medical staffs, and better access to quality imaging may result in more diagnoses, it is evident that these developments have not sufficiently slowed the rate of pitcher injuries across baseball.

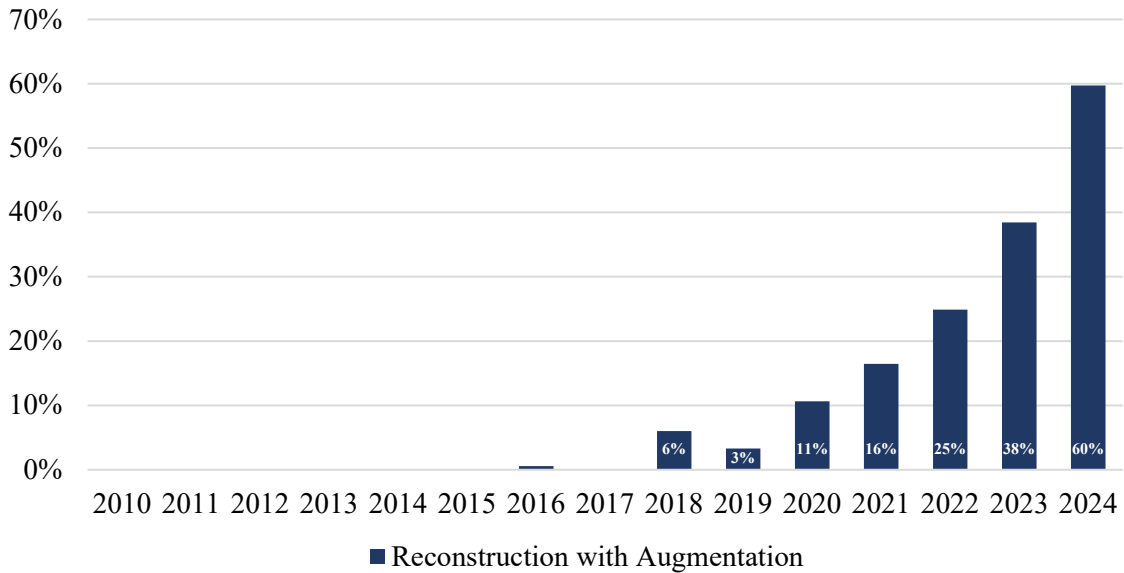
*g. Surgical Advancements*

Of course, once a pitcher has already become injured to the point of needing surgery, the surgical intervention has an impact on future health outcomes. There have been recent advancements and innovations in the surgical treatment of players with elbow injuries that may offer improved outcomes. One recent innovation is the use of an internal brace with reconstruction or repair of the UCL (often called a “hybrid reconstruction” or “augmented reconstruction”). This technique has gained in popularity in recent years, though further data is needed to better understand surgical outcomes and the intervention’s resiliency to future injury. *See Figure 15.*<sup>20</sup>

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<sup>20</sup> Meta F, Meister K, Griffith TB, Conte S, Chalmers PN, Mavrommatis S, Clark S, Hebert E, Camp CL. Epidemiology of Elbow Medial Ulnar Collateral Ligament Surgeries in Major and Minor League Baseball Pitchers: A Comprehensive Report of 2,287 Cases (Unpublished).

**Figure 15: Reconstructions with Augmentation as a % of Total UCL Surgeries**



Several orthopedic surgeons we spoke to expressed concern that although surgery has been able to help players return to play, not all players return successfully. Incorrect perceptions of surgery may unintentionally provide a false sense of security and lead pitchers to push themselves to extreme limits under the misinformed belief that successful return from UCL surgery is guaranteed. While advanced surgical techniques may improve outcomes – and we hope that the medical community continues to make advancements to help players return from injury – they also contribute to this false sense of security, further underscoring the need for better education at all levels of baseball.

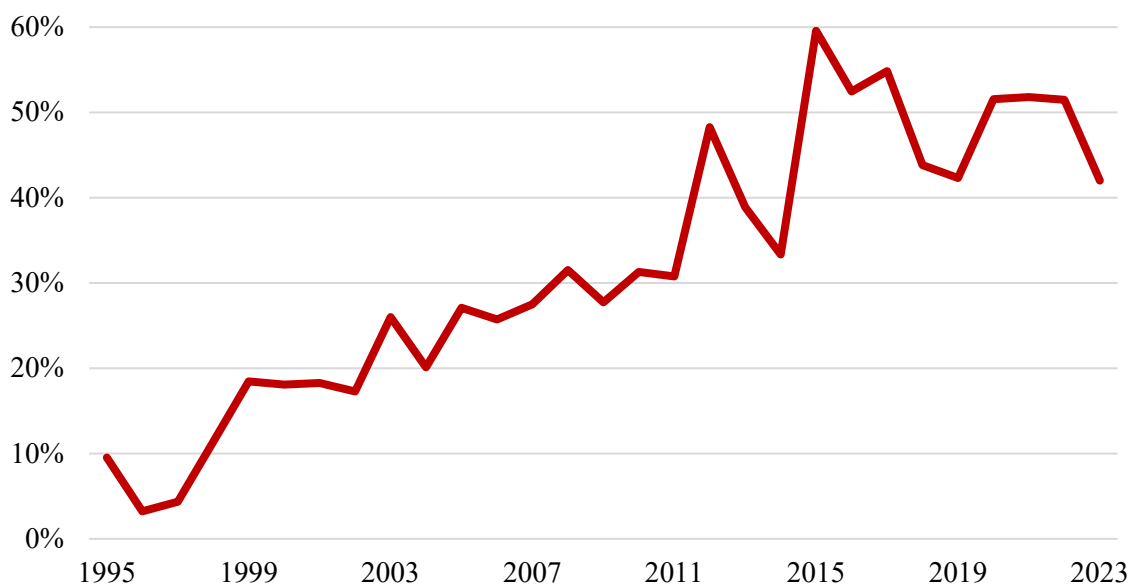
“They have such a faith in the TJ procedure, they’re willing to sacrifice their own elbow knowing if they wind up tearing it, they can get it fixed. By the way, with the new procedures going on, telling them they can get well in half the time with this internal brace phenomenon, it doesn’t help at all with the relationship that pitchers have in their own mind about getting an injury. They don’t realize that 20% of the ones who get it don’t make it back. They don’t know that. They figure it’s worth it, it’s what I’ve got to do to be an elite pitcher, which is to throw 100 mph on every pitch or as hard as I can on every pitch, and take my chances, and if I get hurt I’ll get it fixed.” (Orthopedic Surgeon #9)

*B. Amateur Baseball*

In addition to the foregoing trends in training, development, and performance in professional baseball, the prevailing consensus among experts was that the development, performance, and injury history of pitchers as amateurs significantly contribute to their injury risk

as professionals. And, while we lack comprehensive data to examine injury trends for amateur players, orthopedic surgeons and experts in amateur baseball have observed sizable increases in the frequency and severity of injuries among youth, high school, and college pitchers and publicly available research reports a similar trend.<sup>21,22</sup> See Figure 16. The primary factors identified as contributing to actual injuries at the amateur level and greater injury risk at the professional level include: (1) a focus on the same velocity, “stuff,” and max-effort training and performance that is prioritized in professional baseball; (2) overuse in training; and (3) early sport specialization.

**Figure 16: Youth and High School Pitchers as a Percentage of Overall UCL Surgeries at Andrews Sports Medicine & Orthopedic Center, 1995-2023<sup>23</sup>**



### 1. Velocity, “Stuff” and Pitch Design, and Max-Effort Throwing

Industry experts identified a trickle-down effect of the pursuit of velocity, “stuff” and pitch design, and max-effort throwing from professional to amateur baseball. The current generation of amateur players has ready access to information and tries to emulate how they view professionals training and performing – amateur players are training with similar methods as professional baseball players in an effort to reach affiliated baseball. For many of the same reasons that these

<sup>21</sup> Zaremski JL, McClelland J, Vincent HK, Horodyski M. Trends in Sports-Related Elbow Ulnar Collateral Ligament Injuries. *Orthopaedic Journal of Sports Medicine* (2017).

<sup>22</sup> Erickson BJ, Nwachukwu BU, Rosas S, Schairer WW, McCormick FM, Bach BR, Bush-Joseph C, Romeo AA. Trends in Medial Ulnar Collateral Ligament Reconstruction in the United States. *American Journal of Sports Medicine* (2015).

<sup>23</sup> Internal data provided by American Sports Medicine Institute.



trends in training and performance at the professional level are contributors to injury, amateur players are now entering professional baseball with a higher risk of injury.

Amateur players are throwing with greater velocity than ever before. *See Figure 17.* Amateur players naturally are influenced by what is valued in the Major Leagues, and the amateur scouting environment fosters intense training to improve the metrics, such as velocity, that are valued by Major League front offices and scouts and college scouts.

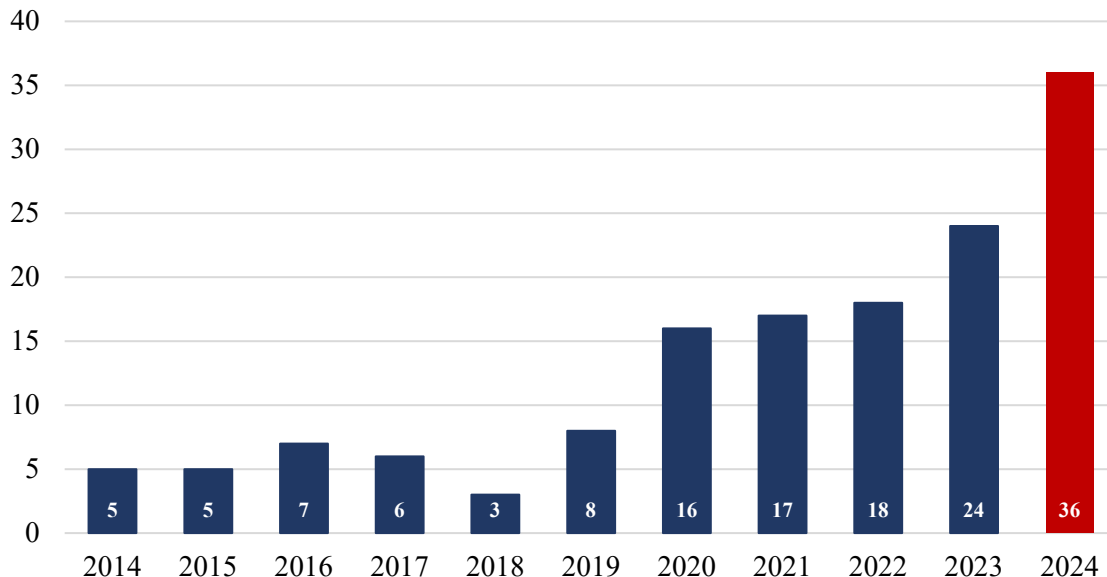
“What the system in the big leagues creates in terms of incentives and what’s valued, and what’s paid, and what are Clubs looking for in order to win – that ends up trickling down with incentives and behaviors. So, what you do in the big leagues, what you value in the big leagues, affects how 30 baseball operations work – draft, international, college, what’s going on in high school, all the way down to little leagues.” (Front Office Executive #1)

“The number you need to hit continues to go up. My impression is that it used to be, you’re a right-handed pitcher and you’re 15, and you throw 85 – you’ll have interest. Now you need to have 90.” (Sports Medicine Physician #1)

“I just think for the system kids are in – chasing rankings and scholarships, possibly being the highest pick – velocity is king. (College Coach #3)

“As a baseball society, we’re pushing velocity so hard right now. It’s such a factor trickling down all the way to youth kids. There’s an obsession with velocity. Don’t get me wrong. It’s a very good predictor of success, but it’s dangerous if not done right. The thing with the athletes is they are always about the results. The majority of them don’t do the things we need to maintain the health while achieving the velocity. I think that, overall, is probably one of the biggest contributors.” (Independent Pitching Development Coach #1)

**Figure 17: Number of Players to Throw 95+ MPH at Perfect Game National Showcase, 2014-2024**



Training for increased velocity, as well as “stuff” and max-effort throwing, generates stress on the elbows of pitchers at any age. But this training poses a unique risk to young, amateur players. Amateurs are less likely to have access to professional trainers and coaches or a comprehensive strength and conditioning program. Professional-style training methods may be particularly inappropriate for young players, who are still growing and may not be physically mature enough to handle rapid velocity increases. In short, there is a greater risk of injury due to the imbalance between the arm strength gains of a young, amateur player, and the development of the rest of his body.

“The velocity keeps going up, guys are getting bigger and stronger – as they keep getting stronger, their ligament doesn’t necessarily get stronger. I see a lot of kids, most people do – some kids rip the bone off their elbow because their growth plate is weaker than the ligament. Instead of the ligament failing, the bone breaks off. That used to happen occasionally, but now it’s happening more and more.”  
(Orthopedic Surgeon #4)

Many former players recalled gradual and natural velocity development over the course of several years – many not in earnest until college – whereas today’s amateur players now have and use the tools to accelerate velocity increases, and at younger ages.

“I believe in the natural development of a player. If you have a good arm and good body, but don’t know how to get anyone out yet, then you need to seek out situations to compete to win a game rather than chase velo. That will come with natural maturation . . . I think it goes back to serious [velocity] jumps that kids are making

at the 14 to 20 year old age marks. It's not what it used to be 30 years ago. The best guys would come here throwing 90 mph through a natural growth progression, adding muscle to their frames. Now it's 'how can I do as fast as possible?' By the time they step foot on campus, the damage is well on its way." (College Coach #3)

"There is a mindset of throwing harder, max effort is definitely the way to go. And as a result, people are training for that at all costs – from early ages up through the Minor Leagues. Every bullpen session – and every throw within those bullpen sessions – is at max intent." (Scouting Director #1)

Even though the injury risks of velocity and max-effort throwing are well understood, many young athletes choose to try to optimize performance. Amateur pitchers experiment with pitch design and other pitch characteristics. Adolescents are also using advanced training methods that may be appropriate for college and professional players, but that may expose them to increased injury risk because they lack the physical maturity needed for those training methods. In a recent study that surveyed players who had participated in a weighted ball program, 85% of respondents reported understanding that such a program was a risk factor for injury, and 17% of respondents "attributed a throwing problem they experienced to their use of weighted baseballs."<sup>24</sup> Youth and collegiate coaches reported that most amateur pitchers have experience with ball-tracking technology and are acutely aware of their spin rates and pitch metrics.

"Guys are seeing big leaguers throwing hard in short bursts. The radar gun is in their face more than it ever has been. I used to appreciate getting outs and having stamina. Kids today know the [velocity] and metrics of every pitch. The last thing that goes on someone's recruitment profile is ERA. It's all velocity, spin rate, vertical break. We're building guys to perform in short spurts. It's a bad formula for longevity and optimal health." (College Coach #2)

"I do think they learn how to pitch in 3 inning clusters instead of throwing 7 innings, 90 pitches in a district game. They spend so much time throwing in 3 inning clusters, and I turn on MLB and see them throwing 3 to 4 innings. This is select baseball right here. Get us to the fifth and just get us another hard thrower, and another hard thrower. That's what the youth model is conditioning pitchers to be. Max effort. Three innings." (Youth Baseball Coach #1)

"Anybody that wants to open up a throwing program in a garage shed can do it, and here's the blueprint. You can look up the program . . . and run it on a local field and put it on Instagram. Now in Houston, Texas you got 37 of them. Now I turn on Instagram and I see guys throwing max effort. They never stop throwing here." (Youth Baseball Coach #1)

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<sup>24</sup> Cross AG, Khalil LS, Swantek A, Lizzio VA, Ziedas A, Camp CL, Chalmers PN, Smith K, Chaides SE, Rexroth JD, Makhni EC. Athletes Perceive Weighted Baseballs to Carry a Notable Injury Risk, Yet Still Use Them Frequently: A Multicenter Survey Study. *Journal of the American Academy of Orthopaedic Surgeons. Global Research & Reviews* (2022).

“It’s hard to flip on social media and ignore everything that top players are doing. 12 to 14 year old kids shouldn’t be doing the same thing that Skenes is doing to prepare for a start. The thought process is helpful but it’s just not taught to kids that they’re not ready for it.” (College Coach #1)

These findings suggest that efforts to educate players and amateur baseball stakeholders about the risks of maximizing performance at a young age alone are insufficient to stem the increase in pitcher injuries. Major League Baseball and its players may need to change their professional training and development practices – and what scouts identify as the most important valuable traits in young pitchers – before meaningful change at the amateur level will be possible.

## 2. Amateur Training Calendar

In addition to the influence of max-effort styles of pitching and training at the professional level, industry experts also identified the volume of year-round, high-intensity throwing as a key driver of injury. Specifically, the travel team and showcase-centric model promoted by stakeholders in amateur baseball (and valued by college coaches and Major League Clubs because of the ease of scouting and availability of performance data) has resulted in young baseball players foregoing periods of rest and recovery, and instead showcasing more frequently – and often despite experiencing symptoms such as fatigue, which is directly associated with injury risk.

“A player goes to pitch one time down at a major tournament. You basically let it loose for that one outing and gun it 92 to 93 to show velocity. You don’t get a D-I scholarship if you’re below 90 mph. Sixth and seventh graders are now trying to get to 90. They’re not built for it yet.” (Former Major League Pitcher #6)

“Amateur baseball does not give players time off. When they get done with the showcase circuit, they go to their pitching guy and work on weighted balls and [velocity] training and try to manufacture strength inorganically. If we try to take away windows of time, they’re still going to throw to try and build [velocity]. It makes sense, because we pay for [velocity] at the Major League level.” (Scouting Director #2)

Amateur baseball organizations have facilitated a culture in which young baseball players throw frequently, with limited periods of rest and recovery. The issue of overuse has been further exacerbated by max-effort throwing practices that are being adopted by youth baseball players, who reach professional baseball with injury histories that predispose them to further injury.

“There’s an epidemic at all levels of baseball. We’ve seen an increase in players reporting to campus with previous injuries. It’s changed in the last 10 years. There are real changes in workload trends, the nature of travel ball, how they pitch in high school, and how they throw in high school. I have a 14-year-old who is pitching and can see how young kids are being handled. When they’re 8 to 12 they throw

more than I'd ever think of throwing on a weekend: 3 innings on Friday and 6 on Sunday. Then, when they're 15-16, they throw less than they ever have. It's a myriad of factors. Their workload is not the same. They're chasing stuff and short burst velocity. They don't, and can't, play multiple sports due to program demands." (College Coach #4)

"We can play baseball 12 months out of the year here. I will see pitchers in Texas, they want to start the ramp-up in November. November, December is when you'll see most guys start a ramp-up period. We'll start playing scrimmages in February. In February, you'll see 1-2 inning outings. Then we'll go into a tournament season for high school baseball. Then you'll be throwing at 75 pitch counts, then district, and we'll extend to 90-100, then we'll have playoffs. Depending on when your playoff team gets eliminated, is how much you pitch before summer. They pitch every week on their summer team, then they pitch in Area Codes then they have someone saying we need you for Jupiter and we need you for this. They can't shut down because they have to maintain throwing. Then they throw in Jupiter, then it's like October and they take their 30 days off to get ready for their ramp-up in November." (Youth Baseball Coach #1)

Unfortunately, year-round baseball is embedded in the scouting calendar for elite high school players. Events held throughout the fall and winter promise players the opportunity to gain exposure in front of college coaches and MLB Club scouts. In addition, the most critical scouting window for high school draft prospects is the summer before their senior year; this scouting window is characterized by a series of outings of short duration, high-intensity effort at individual showcases involving arduous (and often cross-country) travel. This schedule makes it difficult for young players to establish consistent maintenance or strength and conditioning programs – making it challenging to complete complementary training during the week – and emphasizes the type of max-effort pitching that poses a significant injury risk. A sample summer showcase schedule for a recent top draft pick is set forth below. *See* Figure 18.

"In between those [Pitch Smart] tournaments they're not doing the recovery they need to do or throwing or getting themselves ready to throw hard. They throw as hard as they can on Saturday, do nothing Sunday through Friday, and then throw as hard as they can next Saturday. They're doing irreversible damage. It's happening as young as 12 years old up until they come to our college program." (College Coach #2)

"When they get to college, we have to reprogram them to a pro-style throwing program. In high school, they go to play in a tournament Thursday to Sunday—where they throw as hard as can—then don't pick up a ball until their next start. This inevitably turns into once-a-week max effort without development in between." (College Coach #3)

“The pressure on these kids to perform and produce – and their awareness of it – was very eye-opening for me. I thought there was a naiveness around just improving and bettering themselves. Now, everyone knows their rankings and knows the pressure around performing at every event. The kids really feel it. The level of intensity that they’re putting their bodies through every draft year is wild. [Monitoring their rankings] is like a second hobby. They know them all, and they spend a lot of time looking at them.” (Scouting Director #1)

**Figure 18: Example High School Player Summer Calendar**

**Summer 2022 Showcase Schedule**

Location	Date	# Pitches
Sanford, FL	06/18	35
Cary, NC	07/02	16
Cary, NC	07/06	38
Marietta, GA	07/10	16
Los Angeles, CA	07/15	16
St. Petersburg, FL	07/23	30
San Diego, CA	08/10	29
Kansas City, MO	08/16	18
Phoenix, AZ	08/28	15
Fort Myers, FL	08/31	8
Fort Myers, FL	09/02	18

In response to growing concerns about overuse at the amateur level over a decade ago, MLB and USA Baseball introduced the Pitch Smart initiative in 2014. Designed as “a series of practical, age-appropriate guidelines to help parents, players, and coaches avoid overuse injuries and foster long, healthy careers,” the program included pitch count limits and required rest recommendations based on player age, along with general recommendations about pitch selection and other on-field activities. The initiative led to a number of positive changes to amateur baseball, such as the adoption of pitch count limits by many organizations.

However, the Pitch Smart program has not achieved its goals. In some cases, this may be the result of an overt lack of compliance among amateur baseball organizations. For instance, a 2021 study analyzing over a thousand young pitchers aged 8 to 14 found that nearly half of players had at least one violation of the Pitch Smart guidelines, with the highest rate of violations in the age eight-and-under division.<sup>25</sup> Interviewees voiced similar concerns, explaining that many youth

<sup>25</sup> Greiner JJ, Trotter CA, Walczak BE, Hetzel SJ, Baer GS. Pitching Behaviors in Youth Baseball: Comparison with the Pitch Smart Guidelines. *Orthopaedic Journal of Sports Medicine* (2021).

organizations are not properly implementing the Pitch Smart guidelines and face no consequences for failing to do so. Ultimately, interviewees asked MLB and USA Baseball to increase the requirements to receive any Pitch Smart Compliance certification and develop a more comprehensive compliance and enforcement plan. Moreover, while the pitch count and required rest rules have had some success in curbing game-to-game overuse injuries, most parents and players appear to ignore Pitch Smart's other recommendations over multiple games or seasons.

“Pitch Smart recommendations get misunderstood by more than 50% of coaches. If a pitcher exhibits the signs of not wanting to throw another pitch, you have to take him out. But these coaches are looking for the signs in the rearview mirror once they're already tired.” (Youth Baseball Coach #2)

Specifically, although teams are often (but not always) adhering to Pitch Smart's single-game pitch count recommendations, youth players often play for multiple teams in different leagues each year. This has resulted in elevated cumulative pitch counts and a lack of dedicated time to recover from pitching. For example, a 2023 study followed 115 players from 10 high schools and found that 84% of pitchers were non-compliant with Pitch Smart guidelines.<sup>26</sup> While just 14% of pitchers in that study recorded pitch count violations, 65% reported playing for multiple teams and 67% reported taking less than three consecutive months off from overhand throwing each year.

“There's no great surprise that we have issues at younger and younger levels. This is the system we have. There's no governance, and the incentive structure is perverted. I was talking about this, this was an 11U nationally ranked team that in 2021 played 154 games. I bet if we sat down with them, we'd be 100% on the same page. The parents that coached that 11U team, they think they're doing the right thing because they think they'll be the winningest winners . . . They're dominated by a very myopic viewpoint, which is why USSSA runs a [ton] of tournaments. And even if they have rules, violating those rules doesn't mean anything. We just have highways that don't have sheriffs on them. That's where we are.” (Youth Baseball Coach #3)

While supportive of the Pitch Smart framework, which includes pitch limits and required rest periods, interviewees believe it can be improved to close certain loopholes. For example, certain manipulation of the guidelines would permit a 9-year-old pitcher to throw 115 pitches over four days (with 75 of the pitches coming in one day) – which was unanimously regarded by interviewees as risking overuse. Moreover, the current structure of the Pitch Smart framework may have unintended consequences – for example, the reliance on in-game pitch count guidelines may ignore the importance of situational self-regulation or less attention to actual signs of fatigue. In addition, the pitch count guidelines do not account for non-game throwing that places stress on

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<sup>26</sup> Erickson BJ, Bowman EN, Camp CL, Freehill MT, Smith MV, Serio N, Ishikawa H, Smith K, Chalmers PN. Characteristics Associated with Noncompliance of Current Pitch Smart Guidelines in High School Baseball Pitchers Throughout the United States. *Orthopaedic Journal of Sports Medicine* (2023).

the arm (or in-game throwing at positions other than pitcher). One recent study of a cohort of 11U amateur players found that the number of high intensity throws and pitches thrown outside of game contexts far exceeded the number of in-game pitches, indicating that the bulk of the stress on young pitchers' arms may be coming from outside-of-game environments (and away from the Pitch Smart regulations).<sup>27</sup>

“It’s not just the 25, it’s all the other throws. Imagine you have a kid on a Little League team, so it’s mandatory reporting. He’s your shortstop and closer. That kid can be your starting shortstop, which is a high volume, high intensity position. The nature of that job is they’ll throw often and they’ll have to throw decently hard because you’re trying to get outs. Let’s say that boy or girl is also the closer on the team. Top 6, bottom 6, that kid is going to come in and try to throw seeds. If you’re playing Monday, Wednesday, Friday, they’re never going to have a rest day. You’re going to wash, rinse, repeat, week after week, and you’ll end-up in an overuse state, a fatigued state, which we understand is the greatest predictor of injury.” (Youth Baseball Coach #3)

Finally, multiple amateur baseball stakeholders also pointed to difficulties in tracking compliance when players participate with multiple teams concurrently or when teams participate in events run by different organizations that track usage with separate platforms. Another challenge is that state high school associations have adopted their own guidelines related to pitcher health and other pitch count related guidelines. These decentralized guidelines vary from state to state and have not been vetted by a central organizational body or otherwise confirmed to prevent overuse or protect pitcher health; one recent study found that 23 states “did not make distinctions for pitch count rules based on the athlete’s level of competition, age, or grade.”<sup>28</sup>

Many interviewees – including those who operate amateur baseball events or who coach amateur baseball teams – pointed to parents and players as needing to take more individual responsibility for following Pitch Smart guidelines and recommendations (which may require simplifying those guidelines to make them more easily understood by parents and players). They have also suggested ways that MLB and USA Baseball can take a more active role in monitoring compliance, including via certain technological solutions. Interviewees also recommended that the guidelines be updated to address recent developments in training methods (*e.g.*, weighted baseballs and velocity programs), as well as the amateur training calendar (*i.e.*, year-round baseball) and early sport specialization, because Pitch Smart guidelines can only do so much if

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<sup>27</sup> Freehill MT, Rose MJ, McCollum KA, Agresta C, Cain SM. Game-Day Pitch and Throw Count Feasibility Using a Single Sensor to Quantify Workload in Youth Baseball Players. *Orthopaedic Journal of Sports Medicine* (2023).

<sup>28</sup> Manzi JE, Kunze KN, Estrada JA, Dowling B, McElheny KD, Dines JS, Carr JB. Variability in Pitch Count Limits and Rest Day Requirements by State: Implications of Season-Long Pitch Counts in High School Baseball Pitchers. *American Journal of Sports Medicine* (2022).



players still find incentives to participate in an over-committed training calendar that leaves little time for rest and recovery.

### 3. Early Sport Specialization

The American Orthopedic Society for Sports Medicine (“AOSSM”) identified the practice of young athletes only playing a single sport competitively year-round as a meaningful risk factor for injuries due to overuse. In 2016, AOSSM issued a consensus statement that early sport specialization has been associated with “increased rates of overuse injury, burnout, decreased motivation for participation and sports withdrawal.”<sup>29</sup> In response to these concerns, USA Baseball developed the Long-Term Athlete Development Plan to create a better player development structure for amateur baseball players in the United States, stating that the “current amateur baseball environment fosters a culture of early single sport specialization that is contrary to relevant surveys and research on the subject as it related to long-term development.”<sup>30</sup> In this plan, USA Baseball recommended that single sport specialization begin when players are 14-16 years old but “should be delayed as late as possible within this stage.”

Notwithstanding the identification of this risk factor and USA Baseball’s recommendation, early sport specialization continues to remain a prominent issue. A survey of 102 professional baseball players found that 48% of players specialized in baseball prior to high school.<sup>31</sup> This study also found that those who specialized in baseball prior to high school were more likely to have reported serious injuries than players who did not specialize. Moreover, 64% of those surveyed did not think athletes needed to specialize before high school in order to reach professional baseball. Indeed, nearly without exception, the former pitchers interviewed for the study – which included Hall-of-Famers, All-Stars and others who had long, healthy careers – reported playing multiple sports through high school and avoiding overtaxing their throwing arms at a young age. These pitchers cited early specialization and overuse as a key reason that injuries have increased among modern pitchers.

Perhaps even more concerning, many interviewees cited the recent increase in “baseball only” (or even “pitcher only”) players at younger ages, which further exacerbates the risk of overuse and lack of a diverse athletic experience.

“The first ingredient I recognized was, I was never playing just baseball. I was a pitcher, a quarterback in football, and a guard in basketball all the way through my senior year. Baseball for me was a summer sport. It started in the spring, and as I

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<sup>29</sup> LaPrade RF, Agel J, Baker J, Brenner JS, Cordasco FA, Côté J, Engebretsen L, et al. AOSSM Early Sport Specialization Consensus Statement. *Orthopaedic Journal of Sports Medicine* (2016).

<sup>30</sup> USA Baseball. American Development Model. [https://api.mobilecoach.org/static/asset/pdf/131\\_0af48d1c-d21b-45af-9ab9-d32a25b95937\\_default.pdf](https://api.mobilecoach.org/static/asset/pdf/131_0af48d1c-d21b-45af-9ab9-d32a25b95937_default.pdf).

<sup>31</sup> Wilhelm A, Choi C, Deitch J. Early Sport Specialization: Effectiveness and Risk of Injury in Professional Baseball Players. *Orthopaedic Journal of Sports Medicine* (2017).

got older it was earlier, but it was March at the earliest, to July and August. For starters, I was either a basketball or football player. I'm a proponent of playing different sports for a number of reasons. It makes you a better person, and a more well-rounded athlete. I think that to be a good baseball player you're well served by playing different sports. You learn your body movements better, develop strength in different ways, and become more athletic. I think you also become a better baseball player. From when I was little through the age of fifteen, I had the experience of playing two to three months of baseball then being done. I never played Club, never played travel ball. I didn't know if it existed. When I was fifteen, my path got more unique. We didn't have a summer team in my high school area, so I pitched twenty innings as a sophomore on varsity. I wasn't allowed to pitch in JV, so I threw twenty innings as a sixteen-year-old. When the season was over, I didn't pitch. So, I pitched sporadically, then I was done." (Former Major League Pitcher #10)

Other industry experts cited the issue of early specialization in baseball at the expense of participation in other sports as a key driver of injuries at the amateur level. Multiple interviewees also expressed concern about the mental health of young athletes who are "professionalized" at such a young age, particularly for adolescents who may be required to engage in a lengthy rehabilitation from a major arm injury.

"The whole developmental process of the game is wrong. We're developing them wrong, especially in the earlier years. We say we want kids to play multiple sports, but we're building young ballplayers to almost only play one sport. And too early in their careers, right? High school is obsolete. Showcases still have priority because who goes to showcases? Scouts, right?" (Major League Athletic Trainer #6)

"They're not athletes. These kids are just specializing in a sport at way too young of an age and they're beating the crap out of their bodies, out of their arms in our industry." (Major League Athletic Trainer #7)

"They have labral pathology in the shoulder. They have medial elbow pathology. That's overuse. That's overuse in an asymmetric sport, and they don't do anything else. Multi-sport athletes don't have nearly as much of that. So, it's overuse, repetitive movements of the same thing over and over." (Sports Medicine Physician #1)

"We're seeing a lot of [stress fractures from L2-L1] in [amateur] pitchers because they're chasing velocity and spin. There's more volume and heavy training during those ages than ever before. We're seeing more and more UCL injuries in younger kids than ever before. They're sport-specific earlier now and there's more specificity than ever before. It's cruel. It's generally not just one event, it's an

overuse type injury. It's like they're old enough to create the power but they're not strong enough to handle it." (Major League Athletic Trainer #8)

"We talk about acquiring multi-sport athletes and have constantly harped on that. The problem is that those athletes are diminishing because of all the sports-related specialization. It's getting out of hand. We really value when guys play multiple sports because if baseball is their best sport, it means they're really good – and that they've competed at sports that they're not as good at and know what it's like to fail. Also, their risk of injury is much less because they're not doing all the same movements in the same patterns." (Scouting Director #2)

"I think that the emphasis on playing multiple sports was very different then from what it is now. On accident, we were cross-training and arms were staying healthier because they had rest and the activities in other sports were keeping the arms healthy too." (College Pitching Coach #2)

#### 4. College Baseball

While injury data is not as public or robust at the college level, experts explained that college baseball has seen an increase in pitcher injuries that tracks with increases at the youth and professional levels. The reasons behind the increased injury rates in college baseball are largely the same as those at other levels (*i.e.*, the focus on velocity, stuff, and max-effort throwing). However, experts pointed to several other factors specific to college baseball that are worth further exploration, including the impact of college workloads, the transfer portal, roster limits, and scouting calendar regulations.

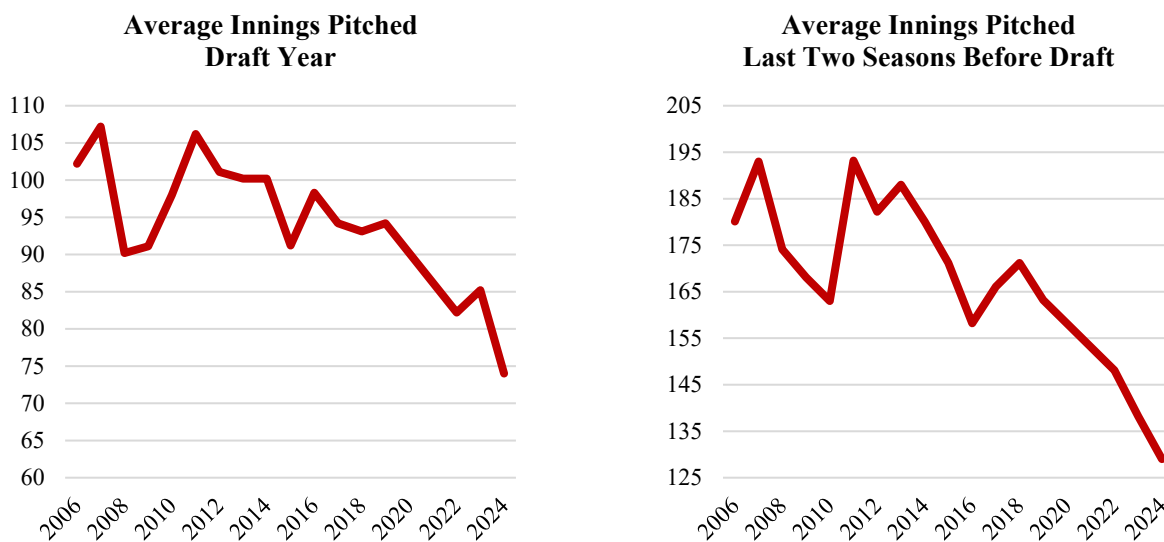
Historically, the largest perceived injury risk at the college level has been the overall volume of pitching that results because of the short-term focus on winning at the collegiate level (compared to the emphasis on long-term player development in the Minor Leagues). This continues to be a major point of concern every year during the college baseball postseason, when young pitchers increase pitch counts and appear on short rest at levels that exceed those in professional baseball. However, college coaches interviewed for this study pointed to significant strides in this area in recent years.

"College baseball has gotten a lot better with proper rest and avoiding dangerous pitch counts. There are still a few bad actors who will outright abuse guys' arms. I can't believe it, but they do and this gives college baseball a bad name. A guy needs to be able to throw the 105<sup>th</sup> pitch because MLB Clubs are evaluating him and he'll need to be able to do that in the big leagues. But these guys who take arms past 120 pitches or have them throwing Friday and Sunday in a Regional . . . that's not right." (College Coach #3)

College coaches pointed to the fact that colleges have begun handling their pitchers more conservatively – both during the college season and in summer baseball environments (including

the USA Baseball Collegiate National Team), with college pitcher workloads following a similar trend to professional pitcher workloads. *See* Figure 19. Such management helps to assuage concerns regarding the high volume of college pitchers. However, similar to professional baseball, such conservative workload management will allow college pitchers to throw at maximum effort more frequently, which may contribute to injuries that the workload restrictions are designed to avoid. To effectively determine the effect of collegiate workloads, we believe that further analysis of players who have pitched to significant volume in college, and who later pitched in the Major and Minor Leagues, is warranted.

**Figure 19: Average Workload for College Starting Pitchers Drafted in Top 3 Rounds, 2006-2024<sup>32</sup>**



In addition to workload concerns, interviewees also pointed to the ability for college athletes to more easily transfer between schools (via a mechanism known as the “transfer portal”) as potentially having a negative impact on pitcher health. By virtue of being able to transfer players from other schools, top college programs no longer have the ability to develop players over multiple years. Instead, colleges are incentivized to maximize player performance while pitchers are enrolled, leading to strategies designed to increase velocity and performance quickly – the same strategies that increase pitcher injury risk at all levels. Additionally, top college programs have the ability to replace injured players with new, healthy players through the transfer portal between school years, decreasing their incentive to manage and develop pitcher health.

“I think things have really ticked up since COVID and the transfer protocol. Now as an eighteen-year-old kid, you have to compete against college kids. As an eighteen-year-old you have to show up on campus and be able to compete right then and there. The development is gone. These rosters turn over. They bring in

<sup>32</sup> Excludes players drafted in 2020 and 2021 to avoid impact of COVID-shortened seasons on player workload data.

22, 24 kids every fall at the D1 level. So, if you get recruited, they're not going to see what you do at 21. They're bringing in someone who's already done this at the college level. Their incentive to come in ready-to-go is higher or else you're going to get smoked out." (Sports Medicine Physician #1)

Many experts believed that increased roster limits as a result of COVID may also potentially contribute to pitcher injuries in the same way, as it made it easier for schools to stockpile pitchers and allow them to perform in short stints at maximum effort. Although it is not clear whether that theory has merit, the NCAA is expected to adjust roster sizes from 40 to 34 in fall 2025. On the one hand, many coaches expressed concern that a lower roster limit would force pitchers into workloads that would put them at risk of injury; on the other hand, many experts suggested that smaller rosters would force schools to value durability, and decrease reliance on velocity and max-effort pitching. Such an effort could counteract any effect that the increased roster sizes had after COVID.

Many experts believe that collegiate baseball has taken steps that indirectly improve pitcher health by reducing incentives at the high school and youth levels to develop pitchers in unhealthy ways. For example, the NCAA recently implemented recruiting restrictions that prohibit coaches and potential recruits from communicating prior to August 1 of a player's junior year of high school. Industry experts believe that such recruiting restrictions will reduce the institutional pressure to gain velocity and perform at showcases at younger ages. Interviewees suggested that we consider additional methods to slow down or regulate the collegiate and professional recruiting and scouting processes. This could include establishing periods of time during which players would not feel pressure to showcase themselves and could instead focus on recovery and training.

"One of the best things that has happened in the youth game is they changed the rules about college recruiting and they're not allowed to talk to players until they enter their junior year in high school. Now you don't have to rush to get to 90 MPH to get a commitment to a Power 5 school in the ninth grade. It allows our late bloomers a reset to progress at their own pace." (Independent Pitching Development Coach #4)

### *C. International Baseball*

Experts also expressed interest in better understanding pitcher injuries in the context of international baseball as a comparison to the growing rates of injury in domestic professional and amateur baseball.

#### 1. International Player Development System

One understudied area is how the international amateur player development system, specifically in Latin America, may contribute to pitcher injuries in professional baseball. Interviewees involved in international amateur baseball identified a number of factors that may contribute to future injury risk and that mirror changes to the United States amateur baseball

system. For example, there has been an influx of technology and new training methods such as weighted ball programs for international amateur players. MLB Club international scouting departments increasingly rely on pitching metrics to make signing decisions, and individuals who train players use technology to improve performance more quickly. In addition, the scouting process for international amateurs is largely driven by showcases and tryouts for individual MLB Clubs. As in the U.S., these events consist of short outings focused on performance metrics rather than durability. Interviewees noted that the volume and frequency of these events have increased dramatically in recent years, leading to concerns of overuse.

*a. Players Throwing Harder at Younger Ages*

International players can sign professional contracts as young as 16, which is roughly two years younger than the age at which high school players become draft-eligible and five or more years younger than college draft picks. In recent years, international players—particularly in the Dominican Republic and Venezuela, which account for more than 80% of international amateur signings—have begun to showcase for Clubs at younger ages, which requires players to leave home to develop their skills earlier. Older international pitchers—a definition often used to describe players just 17 or 18 years old—are generally paid less than their younger counterparts; 90% of international amateur bonuses go to players in their first eligible year to sign, which only increases the pressure on young pitchers to develop quickly. Experts note that it is not unusual for a player to enter a trainer’s academy (*i.e.*, live with the trainer and play baseball nearly full-time) at age 10 to 11 in preparation for imminent Club tryouts, and pressure to audition for Clubs at younger ages results in pressure to throw hard at younger ages.

“[At tryouts with players aged 12 to 14], we’re expecting them to throw 90. So, the agents have that pressure to have them throw faster, more quickly than their bodies develop. So, when [the Clubs] get them, it’s not like ten years ago, when their arms were fresh. It’s not like before. We can’t expect kids 14 to 16 to throw upper 90s, but they’re doing it. So they’re going to get hurt eventually.” (Scouting Director #3)

“Scouts and teams are asking us to have these guys throw 90 plus miles per hour when they’re not even 15 years old. It’s difficult – not all arms can throw that hard at such an early age. The industry is just breaking these players physically and mentally.” (International Trainer #1)

“I recently discussed the overuse of pitchers with another agent, and he said something true: ‘If you don’t move quickly, you aren’t getting money.’” (International Trainer #2)

“[Players older than 16 or 17] have no value, so you need to accelerate from early on in order to get value, which means a lot of stress on these arms, a lot of pressure, too many high-intent throws.” (International Trainer #3)

“They work so hard from a young age that by the time they get to the pros, they are just tired and break.” (International Trainer #4)

*b. Overuse in Showcase and Tryout Process*

The international scouting process is largely decentralized. Baseball is for the most part played outside of schools in Latin America, and so the scouting calendar is not organized around regular seasons. There is an overactive (and growing) showcase scene, but in the absence of a regular game schedule to scout, Clubs also regularly conduct individual tryouts with players, often with technology, before agreeing to deals. As a result, young international players find themselves stretched thin, trying out for any and all interested Clubs, leading to increased fatigue.

“We all want to see the pitching, and they’re going to do anything they can do [to be seen]. They’re going to show the player to us and to someone else tomorrow. It could be four times a week, or if somebody’s hot on the player, he might throw five times.” (Scouting Director #4)

“We are putting too much work and stress on these young bodies. I have seen pitchers doing two tryouts a day, others doing four tryouts of 35 to 45 pitches or more in a week. It’s just crazy. There is a lot of gym work, then they will go to games, and then a day after, a Club will ask to see a player in a tryout, and there’s not even a break of two days between these activities.” (International Trainer #1)

“I witnessed a pitcher throwing four consecutive days of 40 pitches. If you count showcases and tournaments, *etc.*, they could be throwing in games three to four times a week for months.” (International Trainer #2)

“Too many tryouts, and if you try to protect the pitcher’s arm and keep him healthy, you won’t be able to sign him when it matters in the international landscape timeline.” (International Trainer #3)

*c. Training Programs and Transition to Professional Baseball*

While international pitchers may suffer from overwork—too much, too fast, too soon—they are not necessarily training in ways that prepare them for the jump to the professional levels. International academies often lack the state-of-the-art, professionally staffed maintenance and conditioning programs of the domestic professional levels, and some do not have conditioning programs at all; to the extent that international amateur prospects are participating in strength and conditioning programs, they are not always properly taught.

These issues are exacerbated by the de-prioritization of developing pitchers internationally. For example, only two of the current top 50 international players for the 2024 International Signing Period are pitchers and there are no international pitchers listed among the Top 100 Minor League prospects as of July 2024 (as reflected in the MLB Pipeline rankings). Top trainers focus on

developing position players and many of those with specialized knowledge in pitcher development—and how to safely develop pitchers—have left the industry.

“As investment on pitchers at the [international] amateur level continues to go down, people with some knowledge of pitching are just moving away. It’s not profitable – you are on the road with a pitcher three or four times a week for tryouts, and then a team will offer you ten thousand dollars. As a consequence, you have inexperienced trainers trying to make young pitchers throw hard with bad mechanics and a high volume of throws. They just don’t know.” (International Trainer #5)

Those interviewed pointed to enthusiastic use of publicly visible products like weighted balls, but without proper plans or supervision.

“Given the rush in the market, there has been increased use of weighted balls and long toss, trying to get [velocity]. The industry is just breaking these players mentally and physically.” (International Trainer #1)

Nonetheless, upon signing, these players are expected to dive right into rigorous professional training programs, and to keep up with high school or college players who have years of experience.

“They’re getting signed at 145, 155, 165 pounds and have never lifted a weight before, and they’re getting put into the same strength and conditioning program as a 22-year-old domestic player, a college pitcher who is five or six years older and used to that kind of program . . . too much too soon is a killer in anything.” (Scouting Director #4)

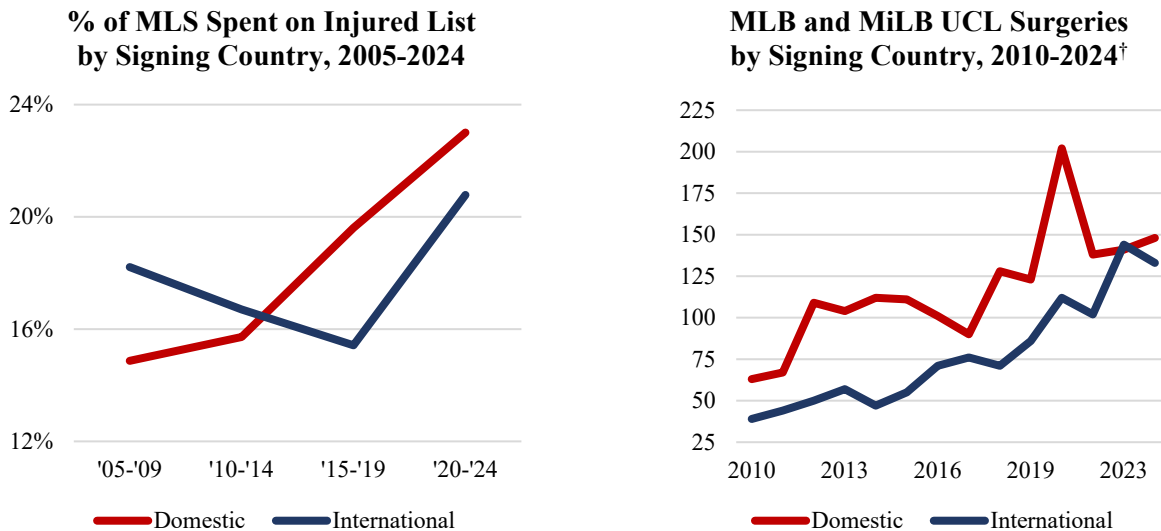
Because there is even less data and information available on player workloads and behavior internationally, it is not clear whether injury rates differ based on entry system (domestic draft versus international), though limited data suggests that international players may be injured at a higher rate. For example, a recent study examined results from a 2021 MLB medical and scouting event in the Dominican Republic.<sup>33</sup> 33 amateur pitchers (average age of 18.2) underwent a series of assessments, similar to the ones performed at the MLB Draft Combine. Researchers found that these amateur pitchers had high numbers of notable MRI findings: 94% had rotator cuff pathology, 76% had labral tears, and 82% had UCL abnormalities. Additionally, international players had more UCL surgeries than their domestic counterparts in 2023 for the first time since 2010 according to internal data. *See* Figure 20.

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<sup>33</sup> Fortney TA, Luzzi AJ, Tenner ZM, Ma K, Rogalski BL, Ahmad CS. The Prevalence of Shoulder and Elbow Pathology in Major League Baseball Prospects from the Dominican Republic. *Sports Health* (2024).



**Figure 20: Comparison of Time on Injured List and UCL Surgeries by Country of Residence at First Signing**



As a next step, we recommend additional research on the international amateur player development system to better understand trends in pitcher injuries for players coming through that system and how those trends compare to players who enter professional baseball through the First-Year Player Draft.

## 2. Foreign Professional Leagues

Interviewees also suggested that it would be worthwhile to compare foreign professional leagues with domestic professional leagues to compare the impact of pitching and training in foreign professional leagues to our own. In particular, Japan’s Nippon Professional Baseball (“NPB”) serves as an interesting area of further study, as it is often considered the second-most competitive baseball league in the world and has certain pitching practices that are distinct from those in Major League Baseball. Interviewees described the following as the most notable differences:

- Pitchers start only once per week (compared to MLB’s once every five days) and their workloads are not restricted in the same manner as those of MLB pitchers.
- Pitcher training is focused less on weight training and more on athletic conditioning, such as cardiovascular training and abdominal and core training.
- NPB uses a different baseball (it is considered smaller and tackier than MLB’s baseball).

† Excludes 2020 season

- NPB teams travel less (and are not required to cross time zones) and have fewer games in their season.

Several interviewees referenced anecdotal reports that pitcher elbow injuries are less frequent in NPB, though there is limited empirical research to support these claims.

- One MLB team collaborated with an NPB team on a study to compare pitching performance and injury differences between the two organizations from the 2015-2019 seasons.<sup>34</sup> Researchers noted key differences between the teams, including that the MLB team had higher fastball velocity and greater breaking ball usage. The study also found that the MLB team had a higher number of reported injuries than the NPB team during the study period, though the proportion of injured pitchers to all injured players was not statistically significant between the two groups. Critically, the authors noted that current differences in injury reporting between MLB and the NPB complicate direct comparisons of injury rates.
- Another study offered possible biomechanical explanations for the differences in elbow injury rates between Japanese and American professional pitchers.<sup>35</sup> These researchers found that American pitchers generated greater ball velocity and had greater elbow varus torque than their Japanese counterparts, which may put the American pitchers at greater risk of elbow injury. Japanese pitchers, by contrast, had greater shoulder horizontal adduction torque, greater shoulder abduction at ball release, and greater shoulder international rotation velocity, all of which—the authors hypothesize—actually may put Japanese pitchers at greater risk of shoulder injury.

Because both studies involved limited samples at the individual team level, the researchers recommended future studies to see whether the results would be consistent across the entire leagues. However, robust study of this topic and a direct comparison to MLB might be challenging because (1) NPB does not standardize the collection of injury data in the same way that MLB does with a league-wide electronic medical records system; (2) injured pitchers in NPB are not always given a dedicated roster designation or placed on an injured list, but rather are often given rest periods while on assignment to their minor leagues; (3) the NPB pitcher population may suffer survivorship bias issues – pitchers who lack durability may not ever appear in the NPB, and only the most durable pitchers may pitch in the NPB, thereby suppressing injury rates; and (4) NPB

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<sup>34</sup> Crotin RL, Yanai T, Chalmers PN, Smale KB, Erickson BJ, Kaneoka K, Ishii M. Analysis of Injuries and Pitching Performance Between Major League Baseball and Nippon Professional Baseball: A 2-Team Comparison Between 2015 to 2019. *Orthopaedic Journal of Sports Medicine* (2021).

<sup>35</sup> Oi T, Yoshiya S, Slowik J, Diffendaffer A, Takagi Y, Tanaka H, Nobuhara K, Fleisig GS. Biomechanical Differences between Japanese and American Professional Baseball Pitchers. *Orthopaedic Journal of Sports Medicine* (2019).

pitchers do not throw as hard as MLB pitchers (*See* Figure 21), though the velocity gap between the two leagues has narrowed over time.<sup>36</sup>

**Figure 21: Average Fastball Velocity in MLB and NPB, 2020-2024**

Year	MLB	NPB
2020	93.3	89.9
2021	93.6	90.3
2022	93.8	90.7
2023	94.1	90.9
2024	94.2	91.1

Nevertheless, as set forth below, we recommend further study to better understand the relative impacts, if any, of these differences in styles of pitching and training (and whether there are other factors that are relevant).

#### **IV. Impact on Professional Baseball**

Pitcher injuries – both actual injuries, and the potential risk and consequences of future injury – are bad for players and the game. Pitcher health directly impacts fan engagement. Pitcher injury rates and the associated risk factors (like max-effort pitching) go hand in hand with the modern style of play, including the rise of strikeout-oriented pitching, the decline in prominence of the starting pitcher, and the regular churn of players on and off the roster, none of which are fan friendly.

##### *A. Strikeouts and Style of Play*

The rate of strikeouts has steadily climbed in professional baseball. MLB Fan Research has shown that fans overwhelmingly want to see an increase in on-field action and the number of balls hit into play. But, as the strikeout rate rises, action created by balls in play has decreased. *See* Figure 22. The increase in strikeouts is directly correlated with increases in velocity, stuff, and max-effort pitching. (Although the strikeout rate appears to be decreasing in recent years, this decrease is largely attributable to the universal Designated Hitter and the elimination of pitchers hitting.) Interviewees believe that teams began to value pitchers who could accumulate strikeouts more than other types of pitchers, and accordingly value pitchers who have the pitch characteristics (velocity and “stuff”) and style of pitching (max-effort) to record strikeouts. As discussed further in Section IV.D below, pitchers train to pitch in this fashion because these characteristics are valued by Clubs.

“We saw the strikeouts go up. People started getting rewarded for that, paid for that. We started seeing velocity and the analytics showing what creates value, what

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<sup>36</sup> Longenhagen E. Update to the Board: NPB Prospects. FanGraphs (2022).

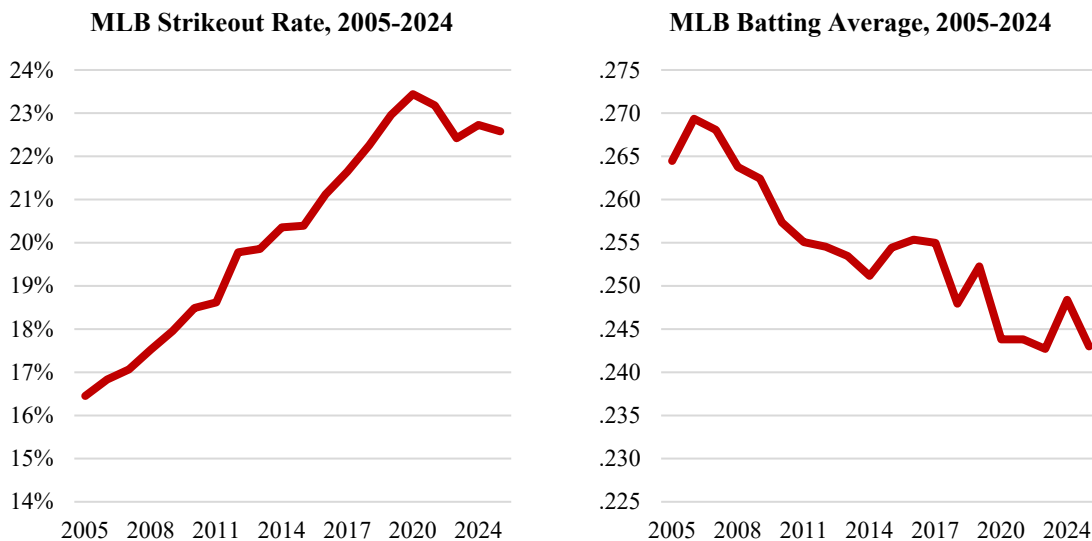
creates performance. Through time, what’s been happening is that there’s better bullpens, stronger arms now. You can shorten-up the game now. It didn’t used to be like that. It used to be more of a contact-oriented game. As soon as hitters began to be rewarded for home runs, they chased that, and pitchers chased strikeouts and that changed the whole game.” (Major League Pitching Coach #1)

“As far as us thinking about the old style of contact, that’s not being rewarded now. Guys are winning Cy Youngs with 160 innings . . . that’s the reality of it.” (Major League Pitching Coach #1)

“A lot of that stems from what Clubs are pushing them on, evaluating them on, and compensating on. If you see a guy getting great K/9 numbers getting paid, you’re going to go try to strike a bunch of guys out. You need good ride on your four-seam. You need this much depth on your breaking ball. And you’re going to go train for that. It’s crazy.” (Former Major League Pitcher #5)

“It comes down to how do you want to incentivize and reward durability? From the current culture to constant data measurement to an economic structure that rewards strikeouts. If at the Major League level durability is rewarded, then it’ll become part of the talk of the game . . . Now it’s only Stuff+. Clubs will be reacting to incentives. [In the current system] Clubs merely cycle through to find the next pitching lab creature who discovers vertical break through mechanical tweaks.” (Scouting Director #5)

**Figure 22: ML Strikeout Rate and Batting Average**



Many experts noted that this focus on strikeouts, which has placed a premium on velocity and “stuff,” has influenced the modern style of pitching. Subsequently, pitchers and Clubs have deprioritized command of the strike zone, pitch sequencing, and execution of pitch location.

“I think one thing that’s hurt us is pitches standing alone on their own merit. We try to throw pitches that grade out on their own, when pitching is really a sequence of pitches – a fastball inside, off-speed away. And the off-speed doesn’t have to have X inches of break, it’s also the placement of pitches . . . if you can marry these ideas, then your pitching doesn’t need to be so nasty. But when you don’t practice control and sequencing, you’re just relying on the brute force of it and throwing as hard as you can or snapping it as hard as you can, which is different from what the older pitches did who were so successful.” (Major League Pitching Coach #4)

Many experts noted that the focus on strikeouts contributes to a style of play that has largely been the result of strategic decisions by Clubs to optimize performance. For example, because of familiarity and pitcher fatigue, hitters generally become more effective against pitchers after the pitcher has faced the batting order more than twice (often known as the “third time through the order penalty”). Because hitters generally become more effective the more frequently they face a pitcher, Clubs have decreased starting pitcher workloads, and often turn to the bullpen after the starting pitcher has gone through the lineup twice.

Some industry experts speculate that max-effort throwing has evolved with changes in batters and hitting approaches, resulting in a cycle where modern hitters have prioritized hitting for power and modern pitchers have been further forced to pursue swings and misses because batter contact is likely to result in a well-hit ball.

“The Jim Kaats and Jim Palmers, they were pitching in a world where maybe there was one guy in the lineup who could hit an opposite field home run. Where if you saw it, it was like holy shit that guy just hit an opposite field home run . . . Now you don’t blink if you see the number nine hitter do it.” (Front Office Executive #1)

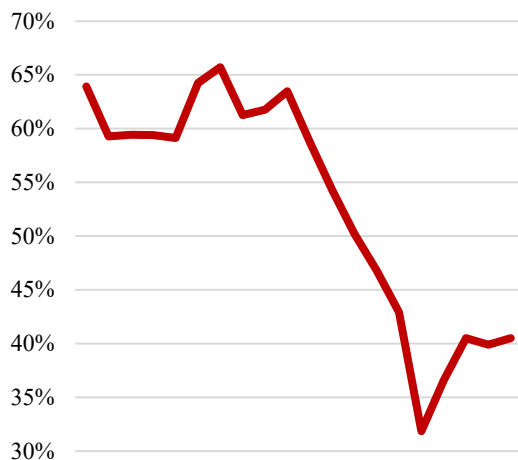
“People don’t understand how much better the hitters are today. It’s crazy how good the hitters are. Just because they lag the pitchers, doesn’t mean they haven’t gotten better. If the pitchers regressed to 10 years ago, the league would regress, and you’d see these crazy box scores like in AAA.” (Independent Pitching Development Coach #1)

### *B. Pitcher Durability*

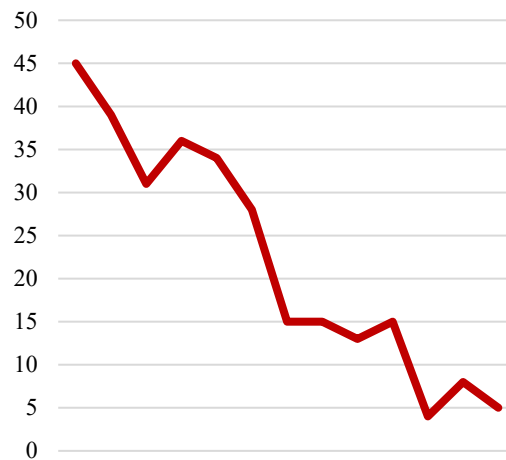
As described above, there is a growing trend in player development that results in pitchers not being sufficiently durable to sustain a typical Major League workload. In this respect, it is not surprising that the number of innings pitched per pitcher is decreasing across professional baseball. Starting pitchers work less per outing and fewer starters pitch deep into games than ever before.

See Figure 23. The number of starting pitchers who reach the threshold of 200 innings in a season has also declined dramatically. See Figure 24. These trends run directly against the interests of fans.

**Figure 23: Percentage of Games with 6+ IP by Starting Pitcher (2005-24)**



**Figure 24: Number of Starting Pitchers to Reach 200+ IP (2010-24)†**



Injuries are a primary driver for the decrease in pitcher durability. As pitchers are less available, they pitch less. But starting pitchers also pitch fewer innings because they seek to maximize velocity and “stuff.” As data has demonstrated that pitcher performance declines the more frequently a batter faces the same pitcher within a game, Clubs have encouraged starting pitchers to throw their best stuff over fewer innings, leaving the balance of the game to relief pitchers, who also are throwing pitches at max-effort over short stints.

“Through developing and creating more pitching talent, ten to twelve years ago, our strategy would have been everything is about how to chew through a starting pitcher to get to the underbelly of a bullpen. Now I want nothing to do with a bullpen. Now I want starting pitchers to stay in as long as they can. So, the bend but don’t break, to get their pitch count up – guys four to eight in the bullpen are so much nastier than they were ten years ago. There is no soft spot . . . we’re producing way more pitching than we ever have.” (Front Office Executive #3)

Players and Club officials described a stark contrast in the mindset of contemporary starting pitchers to those in prior generations. Pitchers now prioritize achieving certain metrics for pitch characteristics and “stuff” or velocity rather than trying to accumulate total innings pitched. Whereas 200 innings pitched over the course of a full season was once the goal, starting pitchers now strive for different measures of performance.

“They wanted to get 200 [innings]. If they couldn’t get 200, they wanted 190. We couldn’t get guys to skip a start because they wanted to get 200. Now it’s just ‘stuff’

scores. Once they show it, once they know they show enough data to be attractive to Clubs, they don't care. They don't even care what their ERA is sometimes. They know it's the pitch data." (Front Office Executive #1)

"One of the prominent pitchers, I won't say his name, came to me and said guys are winning the Cy Young with 30 to 40 innings less than me. What incentive do I have to pitch 200 innings?" (Former Major League Pitcher #1)

"That was my goal. I used to break it down to 200 innings pitched was the magic number I'd try to aim for. If I got 200, I'd need to make 33 starts. Number one, I have to make all my starts. 200 divided by 33 is like 6 something. That's what I have to throw per outing. So, my minimum was I need to go throw 6 1/3 innings. I said, I'm probably going to be given 105 pitches, that's probably the average of what I'm allowed to throw. It was like 16 something pitches per inning, so my focus was maybe giving up 1.5 runners per inning because that's my WHIP, so I knew I needed an out or a result every 3.5 pitches. It made me more aggressive . . . but I thought that way because it was about getting to a certain level. I thought if I got six innings in the game, I'd probably get to 200 innings pitched. And I would probably help my team win and I'd probably make money." (Former Major League Pitcher #10)

In short, starting pitchers are no longer incentivized to establish their durability in games over the course of the championship season because Clubs are more willing to rely on relief pitchers than ever before. Instead, they now pursue max-effort performance over much more limited periods of time – putting them at more substantial risk of future injury. These trends similarly raise questions about whether rule changes can be considered to make it more appealing for pitchers to prioritize durability over max-effort performance, in order to improve pitcher health.

### *C. Roster Churn*

Hand in hand with the decreasing reliance on the starting pitcher is the increasing reliance on bullpens and relief pitchers to record more outs. Clubs are developing a larger stable of pitchers in the organization who can contribute at the Major League level – pitchers who throw hard with good "stuff," even if they cannot contribute a significant number of innings or otherwise lack durability.

"The floor for talent has really gone up. There's not as much variance. If you go watch a game on YouTube in the 80s, there's a few guys who are really good who could hold their own in today's game. That is just not true today. Every player today is a beast in their own respective way. So, part of the perceived issue there is if the floor is higher, it's harder to be elite. If you decline, the bottom comes up on you real fast." (Independent Pitching Development Coach #6)

Interviewees explained that pitchers are further incentivized to throw at max-effort because pitchers are not expected to get through a full 162-game Major League season. Rather, Clubs can use organizational pitching depth to shuttle pitchers between the Major and Minor Leagues (otherwise known as “churning” the back end of the roster), asking more pitchers to contribute a relatively small number of maximum effort innings. As a result, optional assignments to the Minor Leagues and selections and recalls to the Major Leagues have steadily increased in recent seasons, as has the total number of pitchers used in a season. *See Figure 25.*

“Our yield on Minor League development is higher. We are producing more big leaguers from the pool of Minor Leaguers. That’s why we can churn and do these things at the end of the roster, because the guy we’re going to call up is plenty good. He has plenty of weapons to get through enough guys in a lineup. So, we’re doing a better job with that. And the volume has increased. There are so many more humans that are good enough than there were 10 to 15 years ago.” (Front Office Executive #3)

**Figure 25: Average Number of Pitchers Used Per Club In A Season**

Year	Opening Day to 8/31	Full Season
1970	15.2	16.8
1980	13.5	15.1
1990	17.9	20.0
2000	21.1	22.5
2010	21.2	22.8
2021	31.8	34.4
2022	30.3	32.4
2023	30.0	32.2
2024	30.6	32.5

Clubs are further incentivized to “churn” through relief pitchers because durable starting pitchers generally command higher compensation than do up-and-down pitchers who can pitch effectively in shorter stints of relief with increased velocity and “stuff.” And, as set forth in Section IV.D below, the risk of being “churned” off of the roster has incentivized pitchers to train and throw with methods that expose them to injury.

“We’re going to eliminate the starting pitcher because we’ll bulk pitch the games and it’ll be cheaper.” (Former Major League Pitcher #1)



*D. Player Incentives*

Interviewees highlighted competitive and economic incentives as contributing factors to pitchers being willing to train and pitch in a way that prioritizes “stuff,” despite potential injury risks. Pitchers are willing to make tradeoffs for short-term performance gains, at the expense of potential long-term durability. In short, pitchers are willing to train in a manner that exposes themselves to injury because that style of pitching is economically rewarded, both for the league’s best players and for players trying to establish themselves.

“At a high level, it’s like the inverse incentives of performance and pay, and health. I know that I can stay healthy if I throw 82 and don’t push the envelope. I also know that if I’m a \$10,000 [signing bonus] from the [Dominican Republic] or a 15th rounder, that I’m extremely expendable and if I don’t, I’m watching the guys on TV do the things I want to do. And I know I’m not there and I know I have to push my body that way if I want any chance.” (MLB Club Pitching Development Executive #1)

“Most guys are fringe. They’re up and down, they haven’t landed that contract. They’re a Double-A guy trying to make his debut. Players are not thinking about this issue like the fans are. The mindset is I don’t care what it takes, I don’t care if my injury risk is 5% higher. I am out of baseball if I don’t . . . the players are okay with the risk, they’ll do whatever it takes to throw harder. They know what they signed-up for.” (Independent Pitching Development Coach #7)

“I’m a borderline guy. I don’t think I’m going to make the Club. Every pitch I show needs to be super nasty or else I’m not going to make money . . . when you fall into the fringe category, and you run out of options, you’re a pawn in the system. You either show you’re elite or you’re out.” (Independent Pitching Development Coach #8)

“We understand throwing harder increases your injury risk. That’s true at a population level. Now for the overwhelming majority of human beings on earth who aspire to play baseball at a serious level, that trade-off is worth it. The core dynamic is it will increase global population risk, but for each individual person it’s a smart choice to pursue it because pitching performance is based on having really good stuff and throwing it broadly in the hula hoop of the zone.” (Independent Pitching Development Coach #6)

Historically, industry experts explained, players wanted to avoid being placed on the Injured List because they believed that a question as to a player’s durability would dampen a player’s market value or expected earnings in later years. Interviewees speculated that attitudes toward the Injured List have shifted in recent years, reflecting the notion that attributes associated with improved pitching performance outweigh the risk of time-loss on the Injured List.

“I don’t think there’s any incentivizing. There’s comfort in the IL for a lot of guys. Guys can get paid. I don’t know what to do with the IL. It’s real, you need it, but pitchers are very comfortable using it.” (Major League Athletic Trainer #3)

“They’re rewarding pitchers to do the bare minimum. If I make 16 starts and I get my whole contract, without docking, why would I make the others?” (Former Major League Pitcher #1)

Interviewees described a willingness to push performance limits (and accept the associated placements to the Injured List when warranted) for the additional reason that they continue to accrue Major League salary and Major League service time if placed on the Major League IL – another economic factor incentivizing max-effort and potentially injury-causing pitching styles. In this respect, players and Club officials reported that pitchers are willing to accept injury risk for the ability to pursue additional velocity and “stuff.” This pursuit is particularly heightened by the churn referenced in Section IV.C above – as the competition for pitching positions across the roster (and particularly at the end of the roster) becomes more intense due to modern training methods, pitchers are more likely to accept injury risk to try to make the Major League roster.

“Most pitchers now are fungible up and down guys who are fighting their ass off for opportunities to stay up, to get enough service to someday make some money. So, they’re trying to redline and hit these levels even not in games, to impress the pitching coaches and get more opportunities. And it’s crazy because it’s bad for their long-term health and durability.” (Front Office Executive #1)

“It is a dogfight to get the last couple spots in the bullpen, and guys are pushing the envelope. Going back to the third day, fourteenth rounder, if he stays the same, he’s probably got 1 to 2 years of Minor League baseball. So for him, it’s a calculated risk of I know I need to get better and push it. Because I know naturally, I don’t have it. So I’m willing to push it and risk getting injured to try to achieve my dream. At the same time, it’s not catastrophic; you’re watching guys on TV who can come back. If it was, you’re injured and you can never come back, people would approach it differently. We have skilled medical professionals who are excellent at their trade. You’re willing to take on risk if you know there’s a chance to come back and still be good.” (MLB Club Pitching Development Executive #1)

In the same way that individual players weigh the cost-benefit analysis and choose to prioritize performance over durability in some instances, Club officials and coaches likewise deal with tradeoffs at an organizational or team level when it comes to training and pitching philosophies.

“Now Clubs make a conscious choice. We have a hundred assets, ninety probably aren’t going to be big leaguers anyway. Let’s put them on a program and max out every single one we have. Yeah, more guys will get hurt, but we’ll get more big leaguers and the big leaguers will be more effective. There’s a conscious choice.

You're assuming there will be a much higher injury rate in exchange for better performance. The incentives reward that." (Front Office Executive #1)

"Everyone is throwing harder because they're going on their own or challenging their own body to reach their own ceilings and doing everything they can. Am I concerned? Yes. Will we solve it? No, not as long as people keep chasing velocity. But if I can take a player who has a 1% chance of making it to the Majors and turn it into a 4% chance, and the way to do that is by increasing velocity, then we're going to do that. It's not that I don't care about the player or his health, I care about him so much that I want him to make the majors. If I don't help him try to achieve that goal, I'm doing him a disservice in his development." (Major League Pitching Coach #5)

"Guys seek out strain because they're getting paid to throw 100 MPH and they need to do some things differently and they don't care the cost on their body. They're pushing their body because they're getting to the point in their career where they need to make improvements to get to the next level. I have their dreams in my hand and it's hard for me to tell guys not to do that given the current structure. Let's be black and white, we're incentivizing guys to do this and they could not care less about how their body feels if it's going to get them to the next level. But then it's hard to have these conversations when they have their second and third TJ. It sucks. We and MLB need to put the structures together to let them do that in the safe way and change the incentives." (MLB Club Pitching Development Executive #2)

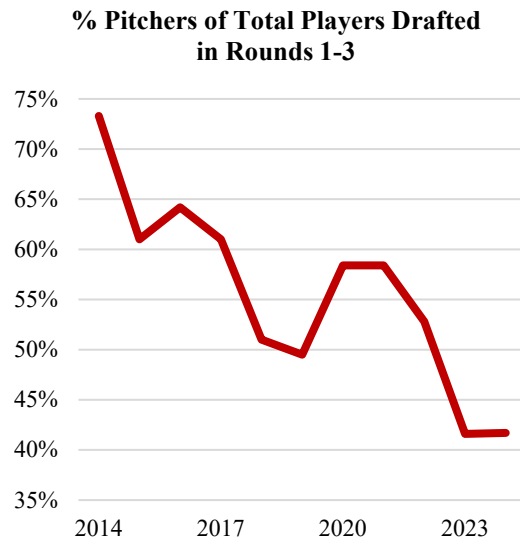
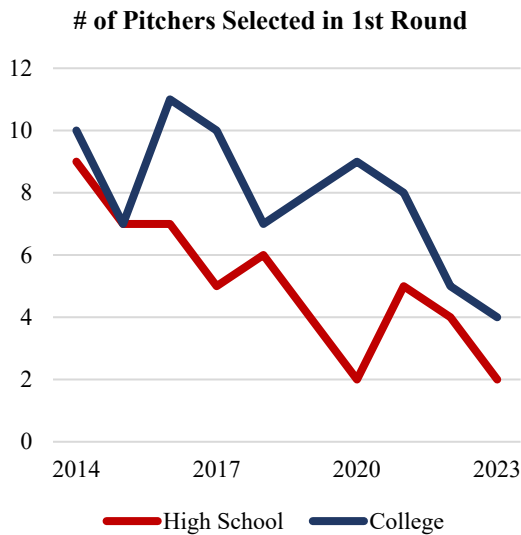
"If you were able to put a governor on the ecosystem that no pitcher would ever get injured, I don't think the teams would get as high quality a player at the other end of the funnel because if we killed all the relentless optimization and population competition dynamic, the teams wouldn't be better." (Independent Pitching Development Coach #6)

### *E. MLB Draft Results*

The increased injury risk from amateur baseball has started to impact Club behavior in the MLB Draft. Clubs appear more hesitant in recent years to use top Draft selections on amateur pitchers via the Draft, as fewer pitchers are being selected with the top (and most lucrative) selections in the Draft. *See* Figure 26.

"High school pitching is generally not the best tree to pick from high up. Further down – if they check all the boxes, it's less risky. Kind of the showcase mentality. Kids are investing in quick velo gains to get D1 offers and get noticed by scouts." (Scouting Director #6)

### **Figure 26: Pitchers Selected in Top Three Rounds of MLB Draft, 2014-2023**



## V. Recommended Solutions and Additional Areas of Research

Injury rates among pitchers have skyrocketed over the past several decades. Injuries not only impact the careers of the affected players, but also are detrimental to fan engagement. Although numerous factors have contributed to these trends, the pursuit of velocity and max-effort pitching at both the professional and amateur levels, coupled with issues in the amateur player development system, are two of the primary forces driving the long-term increase in pitcher injuries. Based on these conclusions, we propose the following short-term and long-term steps to improve pitcher health at all levels of baseball.

### A. *Professional Rule Changes*

Player and Club behavior is responsive to incentives at the professional level. Pitchers and Clubs focus on velocity and max-effort pitching because that style of pitching is perceived to carry greater value both on the field and economically. Many interviewees plainly stated that pitchers willingly and consciously seek to improve performance in these areas, despite the heightened injury risk.

Conventional wisdom holds that the best way to preserve pitcher health is to manage pitchers conservatively – *i.e.*, fewer pitches and more rest. There is, however, a growing consensus that conservative treatment may actually expose pitchers to greater injury risk by encouraging them to throw max effort with every pitch. Indeed, many experts agreed that creating a system

where pitchers are encouraged or required to moderate their activity and throw at sub-maximum effort to go deeper into games may be better for pitcher health.

Experts recommended that MLB consider changes to the playing rules and roster rules to create a better system for sustaining pitcher health – a system that would increase the value of pitcher health and durability, and decrease the value of short-duration, max-effort pitching. For instance, playing rules could be adjusted or designed to encourage or require starting pitchers to preserve enough energy to allow them to pitch deeper into games. These incentives could be supported by roster rules that more appropriately regulate the availability of pitchers on a roster or in a team’s bullpen for a given game, including potential changes to the number and frequency of transactions that allow Clubs to replace pitchers on their rosters. Such rule changes would be designed to increase the value of durable pitchers and incentivize players and Clubs to focus on training for durability instead of short-term, max-effort performance.

### *B. Amateur Baseball*

The increasing focus on velocity and “stuff,” and the failure of existing safeguards to provide meaningful limits on the performance and training of youth pitchers has contributed to elevated injury risks in professional baseball. Because amateur players model their behavior after that of professionals, professional training and development practices – and what amateur scouts identify as the most important characteristics for talented, prospective baseball players – will need to be adjusted before meaningful change at the amateur level will be possible, let alone sustainable. Amateur-specific initiatives will likely have limited impact in isolation.

That said, in conjunction with potential changes in professional incentives, there are still interventions that can curb overuse of youth pitchers and keep players healthier before they reach professional baseball. Specifically, we recommend the following steps:

- *Pitch Smart.* We recommend updating the Pitch Smart guidelines to incorporate best practices (such as closing loopholes that allow pitcher overuse and regulations on the use of weighted balls and velocity training for young players), increasing compliance and enforcement of Pitch Smart standards, and providing better education to players, parents, and coaches.
- *Creating Downtime for Players.* We recommend making efforts to alleviate the pressure on young players to forego rest and recovery. These changes could include effective regulation of the showcase calendar to require pitcher downtime, and the

creation of blackout periods when professional scouts would be prohibited from scouting amateur players.

- *Amateur Baseball Organizations.* We also recommend considering ways to support and partner with amateur baseball organizations that prioritize long-term player health and performance.

### C. Research Initiatives

We believe that additional research in the following areas will further efforts to identify the root causes of pitcher injuries and lead to additional beneficial interventions.

- *Offseason Training and Early Season Workload.* Experts identified two theories for the annual early season spike in injuries that has worsened in recent years: (1) pitchers are overtraining in the offseason, and (2) pitcher workload is not being properly ramped up through Spring Training and the first month of the regular season. Unfortunately, the industry has very limited data on pitcher offseason and Spring Training workload, which makes it challenging to evaluate this hypothesis. In addition, experts remain divided on what the optimal offseason and Spring Training development regimen should entail. We recommend collecting more data on offseason training and Spring Training workload in order to evaluate these theories and make recommendations on the best offseason routines for amateur and professional pitchers.
- *Non-Game Activity.* Experts similarly hypothesized that increased intensity in non-game activities are contributing to injury risk. Here too, the industry has limited data on pitcher non-game training behavior. Again, we recommend collecting more data on non-game activity to consider this theory and make recommendations.
- *Biomechanics and Pitching Styles.* Beyond the high-level consensus that velocity and max-effort pitching have driven an increase in injuries, there is limited consensus on how specific pitching styles, pitch types, or biomechanical markers put players at increased injury risk. This, in part, has led players to prioritize performance over durability. We recommend additional research on the biomechanics and stress of specific pitches, including off-speed pitches, and pitching deliveries (*e.g.*, arm slots, release points, tunneling).
- *Defining and Measuring Fatigue.* Experts cited a lack of consensus on how best to measure fatigue and when certain physical changes are meaningful, as opposed to normal wear and tear that players experience over the course of an outing or season. Additionally, experts cited the challenges of collecting data that would help to improve our understanding in this area because most cannot be collected passively. We propose additional research to improve our understanding of fatigue and how pitchers respond physically over the course of individual outings and throughout the season.

- *Foreign Leagues.* Experts recommended developing a better understanding of pitcher injury trends and injury management in other foreign professional leagues, including Nippon Professional Baseball (“NPB”) and the Korea Baseball Organization League (“KBO”). Injury data from the NPB and KBO is limited and de-centralized among individual teams, making it challenging to track league-wide injury trends. Differences in injury documentation standards, rosters, and schedules also present obstacles to direct comparisons across leagues. Nevertheless, there is interest in better understanding how pitching styles and training methods unique to other leagues can help inform injury research initiatives in MLB.
- *Amateur Baseball Risk Factors.* Experts recommended further research on how amateur players can better balance player development goals with injury prevention. This research also should aim to better quantify behaviors that put players at risk of injury, which has been challenging to-date given the lack of reliable data in amateur baseball compared to professional baseball.
- *Amateur Entry.* Experts suggested that it would be beneficial to compare the relative injury rate of domestic amateurs to the injury rate of amateurs in other countries, such as the Dominican Republic, to determine whether lessons can be learned from other amateur baseball systems. They also recommended further research on injury rates of professionals based on their method of entry into professional baseball (*i.e.*, domestic amateur draft, international amateur signing, or foreign professional).

## **VI. Acknowledgments**

We thank the many individuals who took the time to share their feedback and expertise. We also express gratitude to the membership of the MLB Team Physicians Association, Professional Baseball Athletic Trainers Society, Professional Baseball Strength & Conditioning Coaches Society, and Professional Baseball Physical Therapists Society, who have dedicated their careers to taking care of baseball players and who provided valuable input.