

# Early Sports Specialization Is Associated With Upper Extremity Injuries in Throwers and Fewer Games Played in Major League Baseball

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**Background:** Single-sport athletes who specialize in baseball at a young age may have a greater predisposition to overuse injury, burnout, and decreased career longevity when compared with multiple-sport athletes. The effect of sport specialization has not been studied in professional baseball players.

**Hypothesis:** Major League Baseball (MLB) players who played multiple sports in high school would experience fewer injuries, spend less time on the disabled list, play more games, and have a longer career than athletes who played only baseball in high school.

**Study Design:** Descriptive epidemiology study.

**Methods:** First- and second-round MLB draft picks from 2008 to 2016 who played in at least 1 professional game were included in this study. Athletes who participated in 1 or more sports in addition to baseball during high school were considered multisport athletes, and athletes who participated in only baseball were considered single-sport athletes. For each athlete, participation in high school sports, injuries sustained in MLB and Minor League Baseball, number of days on the disabled list for each injury, number of games played in both leagues, and whether the athlete was still active were collected from publicly available records.

**Results:** A total of 746 athletes were included in this study: 240 (32%) multisport and 506 (68%) single sport. Multisport athletes played in significantly more mean total games (362.8 vs 300.8;  $P < .01$ ) as well as more mean MLB games (95.9 vs 71.6;  $P = .04$ ) than single-sport athletes. There was no difference in the mean number of seasons played in the major leagues (1.8 vs 1.6;  $P = .15$ ) or minor league (5.25 vs 5.20;  $P = .23$ ) between multisport and single-sport athletes. Single-sport athletes had a significantly higher prevalence of upper extremity injuries compared with multisport athletes (136 [63%] vs 55 [50%];  $P = .009$ ). Single-sport pitchers also had a higher prevalence of shoulder and elbow injuries (86 vs 27;  $P = .008$ ) and were more likely to have recurrent elbow injuries (33% vs 17% recurrence;  $P = .002$ ) compared with multisport pitchers.

**Conclusion:** Professional baseball players who participated in multiple sports in high school played in more major league games and experienced lower rates of upper and lower extremity injuries than players who played only baseball in high school.

**Keywords:** professional baseball; pitchers; MLB; sports specialization; throwers

Participation in youth sports has grown rapidly in recent years, with an increase from 45 million athletes in 1997 to 60 million in 2008.<sup>13,14</sup> As this number has grown, we have also observed a high percentage of youth athletes specializing in sports, with 27% of this 2008 cohort focusing on just 1 sport.<sup>13</sup> Sport specialization is defined as year-round training in a single sport to the exclusion of other sports.<sup>12</sup> At the high school level, there are 7.8 million adolescents

playing organized high school sports annually, many of which have specialized in 1 sport before high school.<sup>13,16</sup>

In 2016, the American Academy of Pediatrics released its third policy statement regarding the potential sequelae of early sport specialization and high-intensity training at a young age, including burnout, overuse injuries, and psychological stress.<sup>2</sup> The American Medical Society for Sports Medicine also released a 2014 position statement advising athletes to avoid sport specialization before adolescence.<sup>6</sup> It is believed that sport specialization leads to young athletes not having the opportunity to develop the proper neuromuscular skills and general fitness that can protect against injury.<sup>1,5</sup> McGuine et al<sup>11</sup> prospectively evaluated 1544

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high school athletes and reported an association between sport specialization and lower extremity injuries. Meanwhile, Bell et al<sup>1</sup> showed that single-sport high school athletes were more likely to experience a history of overuse knee and hip injuries.

Baseball requires repetitive technical skills, especially during the act of pitching. In recent years, there has been a dramatic increase in the number of high school and collegiate pitchers undergoing surgery for throwing-related injuries. One study found a 4-fold increase in the number of elbow surgical procedures performed on collegiate baseball pitchers and a 6-fold increase for high school pitchers over a 10-year period.<sup>15</sup> Hodgins et al<sup>9</sup> found a 193% increase in ulnar collateral ligament (UCL) reconstructions from 2002 to 2011 in the state of New York, with a significant increase in the frequency of UCL reconstructions for individuals 17 to 20 years of age.<sup>15</sup> These findings coincide with a 2017 study reporting a higher percentage of high school athletes specializing in baseball (60% vs 45%) at a significantly earlier age (12.3 vs 15.4 years) than they were 10 years ago.<sup>3</sup>

Fleisig and Andrews<sup>7</sup> found that pitching volume is a risk factor for elbow injuries, as an increased number of pitches per game, innings pitched per season, months pitched per year, and pitching for multiple teams were all significantly associated with an increased risk for these injuries. Throwers who pitched more than 8 months per year had a 500% increased risk for undergoing shoulder or elbow surgery.<sup>15</sup> It is speculated that sport specialization in baseball leads to more games played, a longer season, and playing for multiple teams. All of these factors combine to increase the risk for overuse injuries and the potential need for surgery.

The purpose of this study was to (1) compare the incidence in professional baseball players of single-sport specialization versus multisport participation during high school, (2) identify differences in length of Major League Baseball (MLB) career and total number of MLB games played between athletes with a history of single-sport specialization versus multisport athletes, and (3) distinguish differences in injury patterns and their incidence in those with single-sport versus multisport backgrounds. We hypothesized that MLB players who played multiple sports in high school would experience fewer injuries, spend less time on the disabled list (DL), play more games, and have a longer career than athletes who played only baseball in high school.

## METHODS

First- and second-round draft picks for all MLB teams from 2008 to 2016 were identified on [www.MLB.com](http://www.MLB.com). First- and second-round draft picks represented a higher-level baseball

player and were likely to have more public information available as well as a greater likelihood of playing professionally. Athletes who played in at least 1 minor league game were included in this study. A total of 751 athletes were isolated, 5 of whom never played a minor or major league game, resulting in 746 players being included in this study.

For each player, we collected high school sport participation, number of minor and major league games played, number of injuries sustained during minor and major league games, number of days on the DL for each injury, and duration of career. Baseline characteristics were collected, such as age, height, weight, and body mass index at the time of draft, as well as position played. Player data were obtained by searching websites such as [www.MiLB.com](http://www.MiLB.com), [www.MLB.com](http://www.MLB.com), [www.ESPN.com](http://www.ESPN.com), [www.FoxSports.com](http://www.FoxSports.com), [www.MaxPreps.com](http://www.MaxPreps.com), and [www.DraftExpress.com](http://www.DraftExpress.com), as well as undergraduate athletic websites through June 15, 2018. News articles were used when internet data were limited.

Players were considered multisport athletes if they had played a varsity, junior varsity, or competitive club sport in addition to baseball during high school. Sports played before high school or recreationally did not qualify as multisport. We considered as injuries those that occurred during Minor League Baseball (MiLB) and MLB games that resulted in the athlete being on the DL for at least 7 days. Injuries attributed to trauma, including fractures, concussions, contusions, and lacerations, as well as illnesses, were excluded from this study. Injuries were characterized by type, location, and duration of time spent on the DL. The injury had to occur while the athlete was employed by an MiLB or MLB team to be included. MiLB injuries were excluded from sub-analysis of type of injury, as there was a lack of reliable public data for injury details. As a result, type and location of injury were analyzed only for those sustained in MLB games.

Based on [www.MiLB.com](http://www.MiLB.com) and [www.MLB.com](http://www.MLB.com), the total number of games played in professional baseball were compiled. The percentage of possible games played was calculated by dividing the number of games played by the number of games for which the athlete was listed as available.<sup>17</sup> Athlete status was characterized as active on the basis of whether the player remained under contract with the MLB or MiLB.

Athletes were stratified by position into pitchers or position players (nonpitchers). Analysis of injury prevalence and number of total and possible games played was conducted for pitchers only, position players only (nonpitchers), and all athletes (pitchers and position players).

## Statistical Analysis

The unpaired *t* test, 2-tailed chi-square test, and 2-tailed Fisher exact test were all utilized. The specific use of each

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Ethical approval was not sought for the present study.

**TABLE 1**  
Statistical Tests Used to Determine the Differences Between the Multisport and Single-Sport Athlete Cohorts<sup>a</sup>

Statistical Test	Value Assessed
Unpaired <i>t</i> test	Baseline characteristics
Two-tailed chi-square	Field position
Two-tailed chi-square	Number of MLB games played and percentage of total games played
Two-tailed Fisher exact	Number of major injuries sustained, injury type, and current MLB status

<sup>a</sup>MLB, Major League Baseball.

**TABLE 2**  
Mean Baseline Characteristics at Time of Draft<sup>a</sup>

	Single Sport (n = 506)	Multisport (n = 240)	<i>P</i>
Age, y	19.80	20.01	.06
Height, in	74.45	74.13	.29
Weight, lb	198.50	198.59	.95
Body mass index	25.27	25.44	.35

<sup>a</sup>Bold indicates *P* < .05.

test is listed in Table 1. Statistical significance in this study was defined as a *P* value < .05, and all statistical analyses were performed with SPSS (v 24; IBM).

## RESULTS

A total of 746 athletes were identified as first- or second-round draft picks who played in the MLB or MiLB. Of these athletes, 240 (32%) were multisport and 506 (68%) were single sport. Besides baseball, the multisport athletes played football (n = 142), basketball (n = 98), soccer (n = 15), hockey (n = 12), track (n = 7), golf (n = 6), and wrestling (n = 2) in high school. There were no significant differences between the multisport and single-sport cohorts with respect to age, height, weight, or body mass index at the time of the draft (Table 2). When player position was compared between the cohorts, there was a significantly higher percentage of pitchers in the single-sport cohort (51.68%) than in the multisport cohort (41.42%, *P* = .01) (Table 3).

Of the 746 athletes drafted, 326 (43.7%) played in at least 1 major league game from 2008 to 2018. The percentage of multisport athletes who made it to the MLB was 46% as compared with 43% for single-sport athletes. The multisport athletes played in significantly more total games on average (363 vs 301, *P* = .004) and more MLB games on average (96 vs 72, *P* = .04) than the single-sport cohort (Table 4). However, there was no significant difference in percentage of possible games played between multisport and single-sport athletes (84.0% vs 82.4%, *P* = .157). There was also no significant difference in average career length (*P* = .157), mean number of seasons played in the

**TABLE 3**  
Percentage Pitchers vs Position Players<sup>a</sup>

	Single Sport (n = 506)	Multisport (n = 240)	<i>P</i>
Pitchers, %	51.68	41.42	<b>.01</b>
Position players, %	48.32	58.58	<b>.01</b>

<sup>a</sup>Bold indicates *P* < .05.

**TABLE 4**  
Mean Number of Games Played per Player<sup>a</sup>

	Single Sport (n = 506)	Multisport (n = 240)	<i>P</i>
Total games played, n	300.79	362.80	< <b>.01</b>
Major league games played, n	71.60	95.87	<b>.04</b>
Percentage of possible games played <sup>b</sup>	82.4	84.0	.157

<sup>a</sup>Bold indicates *P* < .05.

<sup>b</sup>Games for which the athlete was listed as available.

**TABLE 5**  
Most Common Injuries by Type (Major League Baseball)<sup>a</sup>

	Single Sport (n = 216)	Multisport (n = 110)	<i>P</i>
Shoulder impingement/ tendonitis	39	14	<b>.046</b>
Elbow sprain	23	7	
UCL tear requiring Tommy John surgery	21	11	
Lumbar strain	20	11	
Oblique strain	17	12	
Hamstring strain	14	12	

<sup>a</sup>Data are shown as No. of injuries. Bold indicates *P* < .05. UCL, ulnar collateral ligament.

major and minor leagues (*P* = .15, *P* = .23 respectively), or percentage of total games spent on the DL (*P* = .229).

For athletes drafted in the first 2 rounds from 2008 to 2016, the most common MLB injuries were shoulder impingement, elbow sprain, UCL tear requiring reconstructive surgery, lumbar strain, and oblique strain (Table 5). In MLB, single-sport athletes had a significantly higher number of upper extremity injuries (shoulder, elbow, forearm, wrist, and hand) compared with multisport athletes (136 [63%] vs 55 [50%], *P* = .009) (Table 6). Single-sport athletes also had a higher number of knee and ankle injuries than multisport athletes (30 [14%] vs 10 [9%], *P* ≤ .001). Within multisport athletes, there was no difference in the type of sport played outside of baseball or the athletes' risk of subsequent injury.

When only MLB pitchers were examined, single-sport athletes had significantly more elbow and shoulder injuries compared with multisport athletes (86 [75.44%] vs 27 [56.25%], *P* = .008) (Table 7). Additionally, among pitchers

TABLE 6  
Injuries by Body Part<sup>a</sup>

	Single Sport (n = 216)	Multisport (n = 110)	P
Elbow	42 (19)	17 (15)	
Shoulder	53 (25)	20 (18)	
Forearm	12 (6)	6 (5)	
Wrist	7 (3)	2 (2)	
Bicep	8 (4)	2 (2)	
Hand	14 (7)	8 (7)	
Knee	21 (10)	8 (7)	
Ankle	9 (4)	2 (2)	
Total shoulder and elbow	95 (44)	37 (34)	<b>&lt;.01</b>
Total upper extremity	136 (63)	55 (50)	<b>&lt;.01</b>
Total	166 (77)	65 (59)	<b>&lt;.01</b>

<sup>a</sup>Data are shown as n (%). Bold indicates  $P < .05$ .

TABLE 7  
Injuries by Body Part in Pitchers<sup>a</sup>

	Single Sport (n = 114)	Multisport (n = 48)	P
Elbow	40 (35)	14 (29)	
Shoulder	46 (40)	13 (27)	
Total shoulder and elbow	86 (75)	27 (56)	<b>.008</b>

<sup>a</sup>Data are shown as n (%). Bold indicates  $P < .05$ .

who had at least 1 elbow injury, single-sport pitchers had a higher rate of reinjury than the multisport players (33% vs 17%,  $P = .002$ ). Furthermore, a higher percentage of multisport pitchers made it to the major leagues as compared with single-sport pitchers; however, this result was not significant (48.0% vs 43.7%,  $P = .181$ ). No difference was found in the number of All-Star Game appearances between the groups (16 [14.6%] in multisport vs 29 [13.4%] in single sport,  $P = .700$ ).

When only position players (nonpitchers) were examined, single-sport athletes continued to have significantly more total injuries than multisport athletes (78.4% vs 61.3%,  $P = .013$ ). However, there was no difference in the number of shoulder and elbow injuries between the position player groups (49% vs 45%,  $P = .153$ ).

## DISCUSSION

Limited information has been published on the effects of early sports specialization as it pertains to professional baseball athletes. Our study is the first to report on the incidence of specific baseball injuries, career longevity, and the impact that early specialization has on MLB and MiLB players. Unique to our study was the finding that single-sport pitchers were at an increased risk of upper extremity injury with a decreased number of games played when compared with multisport pitchers. We also found that single-sport athletes experienced significantly higher rates of both upper and lower extremity injuries, suggesting that early sports specialization may be placing young athletes at a

higher risk of injury as they progress throughout their careers. In addition to these higher injury rates, these early specializers played in significantly fewer total games in their careers, including games played at the MLB level. However, there was no difference between the cohorts with respect to possible games played. Therefore, young athletes interested in a baseball career at the highest professional level can minimize their risk of overuse injuries and have the potential for greater future longevity by participating in multiple sports during high school. These findings should be reiterated to parents and coaches who might influence young athletes to train and participate in a single sport.

About one-third of the players included in our cohort were multisport athletes, while a 1980s study on professional baseball players found that well over half of the included athletes in its cohort had played basketball (68.7%) or football (59.3%) while in high school.<sup>8</sup> This recent shift toward specialization has occurred because of the misconception that early sport specialization provides a performance advantage that could lead to an earlier and higher MLB draft opportunity or highly coveted collegiate scholarships. A recent study of collegiate athletes found that the primary drivers of specialization included personal interest, skill level, time constraints, and the prospect of potential scholarship opportunities.<sup>18</sup> This misunderstanding leads parents and coaches to encourage young athletes to play on multiple teams and dedicate more hours to developing their game. However, the athletes themselves seem to believe otherwise. In a study published by Wilhelm et al,<sup>19</sup> only 27% of players believed that early specialization is helpful, while nearly two-thirds (63.4%) felt that early specialization is not advantageous.

In an attempt to ameliorate the misconception of the benefits of early sports specialization, the American Orthopaedic Society for Sports Medicine released a consensus statement emphasizing that early specialization places young athletes at risk for overuse injuries and burnout.<sup>10</sup> Our results concur, as MLB and MiLB players with early specialization had significantly higher rates of upper extremity injuries (shoulder, elbow, forearm, wrist and hand) as well as lower extremity injuries (knee and ankle). Our findings may be due to increased training and throwing volume for single-sport athletes, with many single-sport athletes playing baseball for more months per year than their multisport counterparts. In addition, it is possible that multisport athletes benefit from neuromuscular training through sports other than baseball, causing a protective effect against future injury. This was further reflected in recent data showing an increasing frequency of early sport specialization as well as UCL reconstruction in New York State, particularly in the adolescent thrower between the ages of 17 and 20 years.<sup>9</sup> This highlights the importance for parents and coaches to recognize the connection between early sports specialization and the risk of overuse throwing injuries.

This study has several limitations given our methodology, which has been previously applied.<sup>17</sup> One limitation was the use of internet data to determine if an athlete played multiple sports in high school; however, several published baseball studies have used internet data in their

study design. The inability to accurately determine high school sport participation from public sources is a significant limitation. It is possible that athletes were categorized as single sport when they actually participated in multiple sports during high school. Another limitation is the use of online sources for injury data, which can be inaccurate or incomplete as compared with the MLB Health and Injury Tracking System.<sup>4</sup> Additionally, we did not investigate injuries that occurred prior to the draft. There may have been single-sport athletes who experienced a greater number of injuries in high school and college and were less likely to make it to the first and second draft rounds for the MLB. This is a potential area for injury risk assessment research. Another limitation was the exclusion of minor league injury specifics to include type and location, as these data were not reliably available. Last, we looked at only the first 2 rounds of the MLB draft, which provided us with an athlete cohort with a skill set capable of playing at the professional level; however, this cohort may not be representative of professional baseball as a whole.

## CONCLUSION

Our findings suggest that professional baseball players who participated in multiple sports during high school sustain fewer upper extremity injuries (shoulder, elbow, forearm, and hand) and lower extremity injuries (knee and ankle) while also playing in more MLB games during their career. In addition, pitchers who specialized early in life had significantly higher rates of shoulder and elbow injuries as well as higher reinjury rates. It is important for parents, coaches, and players to understand that the long-term impact of early specialization can have a deleterious downstream effect at the professional level.

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