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Arm Health in Elite Collegiate Summer League Baseball Players Assessed by the Kerlan-Jobe Orthopaedic Clinic Score

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Context: Collegiate baseball players with professional aspirations often participate in summer leagues; foremost among them is the Cape Cod Baseball League (CCBL). Injuries acquired during the collegiate baseball season can be carried into the CCBL season and vice versa.

Objective: To assess the history of throwing arm injury and current functionality in midseason CCBL players.

Design: Cross-sectional study.

Setting: Online questionnaire.

Patients or Other Participants: A total of 123 CCBL players participated. Qualifying athletes were ≥18 years old and were rostered CCBL players with remaining collegiate eligibility.

Main Outcome Measure(s): After collecting background information, we used the Kerlan-Jobe Orthopaedic Clinic (KJOC) Shoulder and Elbow questionnaire to assess the history of throwing arm injury and current functionality. The maximum KJOC score is 100.0; higher scores correspond with greater functionality.

Results: The mean KJOC score was 86.6 ± 14.5 (n = 92); 24.5% (23/94) of players reported a prior diagnosis of throwing arm injury other than a strain or sprain. A total of 49 (49/96, 51.0%) players had undergone rehabilitation for a throwing arm injury, and 7 (7/96, 7.3%) had experienced a medical procedure. Players with no previous treatment (n = 41, mean KJOC score = 88.9 ± 19.0) more frequently demonstrated KJOC scores of ≥90 than players with such treatment (n = 55, 80.9 ± 17.1; $P < .001$). The 18 players with time-loss arm injury in the last year had lower mean KJOC scores (71.3 ± 20.0) than players with no injury or time loss (90.3 ± 9.8; $P < .001$). Similarly, players who reported current arm trouble (n = 15) had lower KJOC scores (71.6 ± 17.5) than players with healthy arms (89.5 ± 11.9; $P < .001$).

Conclusions: The average KJOC score of the CCBL players was <90, with particularly low scores in athletes with prior arm injury and treatment.

Key Words: collegiate athletics, throwing athletes, arm injury, overuse injury

Key Points

- Cape Cod Baseball League players reported Kerlan-Jobe Orthopaedic Clinic scores comparable with those of other collegiate baseball players but lower than professional players.
- Kerlan-Jobe Orthopaedic Clinic scores were lower in players with a history of arm injury or treatment, suggesting that they carried prior injury burdens into the summer league season.
- Athletic training staff and other health care professionals might consider using the Kerlan-Jobe Orthopaedic Clinic score to identify the players at the highest risk for injury during competitive summer league play.

Arm injuries among collegiate baseball players are common. Across 5 National Collegiate Athletic Association (NCAA) seasons, shoulder and arm/elbow injuries combined to account for nearly one-third (32.1%) of all reported injuries among baseball players.[1]

Specifically, overuse is a common mechanism of injury in collegiate baseball players, accounting for 25.3% to 26.1% of all injuries acquired during practice and 11.0% to 13.9% of competition injuries among NCAA baseball players.[1,2] Notably, these injuries are often associated with significant morbidity at both the collegiate and professional levels in terms of time away from sport and quality of recovery.[3,4] Current trends indicate an increasing rate of certain reconstructive surgical procedures among amateur players.[5,6] With some arm injuries ultimately being treated surgically, rehabilitation and return-to-play considerations are important for collegiate-level athletes seeking professional athletic careers.

Several earlier groups defined risk factors for arm injury in amateur baseball players at the youth, high school, college, and professional levels.[7–11] However, no prior researchers have specifically examined throwing arm functionality in a summer collegiate baseball league. Therefore, we aimed to

assess the history of throwing arm injury and current self-reported arm functionality in midseason Cape Cod Baseball League (CCBL) players. We hypothesized that approximately one-third of CCBL players would report previous arm injuries and that current arm functionality, as assessed by the Kerlan-Jobe Orthopaedic Clinic (KJOC) questionnaire, would be comparable with that of professional baseball players given the pool of high-level collegiate talent in our study.

METHODS

Participants

The CCBL, located in Massachusetts, is widely considered one of the most prestigious summer leagues. An estimated 1 in every 6 Major League Baseball (MLB) players has participated in the CCBL. As of October 2019, 1400 CCBL alumni had appeared in at least 1 MLB game.[12–14] However, although collegiate baseball summer leagues offer an opportunity for continued skill development and exposure in front of MLB scouts, these leagues also add to the physical burden of collegiate players. After a collegiate schedule of up to 65 games, CCBL participants play 40 regular season games in addition to a playoff schedule for qualifying teams.[15] The CCBL is an ideal population in which to evaluate injuries during summer league play due to its combination of elite-level talent, high stakes for aspiring professional players, and the potential for exacerbating or developing overuse arm injuries.

Eligible participants were (1) 18 years or older, (2) current or transferring roster members of a collegiate baseball team with remaining collegiate athletic eligibility, and (3) active for at least 1 day on a 2022 CCBL team roster.

Instrumentation

This study was conducted after approval by the appropriate institutional review board. The online survey was created in Qualtrics. The survey collected basic background information, including age, dominant throwing arm, division of collegiate baseball, position(s) played, and number of months engaged in overhead throwing during the prior year. Of note, players who selected the *utility position* (defined as those who have the expertise and opportunity to play >1 defensive position) as their primary position ($n = 2$) were grouped with outfielders ($n = 11$) because utility players are often substituted interchangeably for outfielders. The KJOC Shoulder and Elbow questionnaire, an assessment tool with a numeric output score, was then used to assess outcomes of interest, including throwing arm injury and treatment history as well as current functional status. The KJOC functionality section features 10 questions, each graded on a scale from 0 to 10.0, for a total possible score of 100.0.[16] We programmed these questions in Qualtrics to display a sliding scale, allowing respondents to indicate their preference level to 0.1 points by dragging a bar. Higher KJOC functionality scores correspond with greater arm functionality.

Procedures

The questionnaire was open for completion between June 29, 2022 (33% of the way through the CCBL season) and July 31, 2022 (94% of the way through the season), a total of 32 days and encompassing the middle 61% of the CCBL season. To account for the possibility that injuries or changes in arm functionality were acquired during as opposed to before CCBL gameplay, we analyzed responses to measures of current arm status and functionality in aggregate as well as by point in the season (first half: June 12, 2022–July 8, 2022; second half: July 9, 2022–August 3, 2022) during which the response was recorded.

Team athletic trainers (ATs) explained and offered the survey to all players on 6 of the 10 total CCBL teams. The 6 teams were selected for their experienced ATs who were able to facilitate the survey. Six primary survey administration dates occurred during the study period, which was sufficient to offer the survey once to each of the 6 targeted CCBL teams. Players who agreed to participate provided consent before electronically completing the confidential survey on mobile devices or tablets during pregame warm-ups. Confidentiality was maintained by allowing players to complete the survey privately without external influence; additionally, no identifiable information was elicited or stored in the secure Qualtrics database. The team AT and additional study authors were present to answer questions. Each of the 6 targeted teams carried a maximum of 30 players on the active roster. A total of 123 players were involved, yielding a response rate of 68.3% (123/180).

Given the voluntary nature of participation, respondents were not required to answer every survey question. Surveys in which respondents provided answers to $<80\%$ of questions were disqualified and excluded from analyses. We selected this cutoff a priori as a reasonable compromise between including surveys in which participants abstained from answering specific questions and ensuring that incomplete or missing data were limited and numeric comparisons across survey questions remained relatively even. In total, 27 responses (22.0%) were excluded from analysis due to $<80\%$ completion. Ninety-six responses were at least 80% complete and were therefore included in the analyses. Of the 96 responses, 92 players answered all questions in the KJOC functionality section and were included in analyses specific to KJOC scores.

Statistical Analysis

The tables and figures were compiled using Word, Excel (Microsoft Corp), and Prism (GraphPad Software). Data outliers were identified by the 1.5 times interquartile range (IQR) rule, using the IQR and quartile 1 (Q1) as well as quartile 3 (Q3) to calculate lower and upper boundaries, where the lower boundary $= Q1 - 1.5 \times IQR$, and the upper boundary $= Q3 + 1.5 \times IQR$.[17] Outliers were noted so that a mean KJOC score excluding outliers could be calculated to facilitate comparison to previously published KJOC scores. Data were assessed for normality using the Shapiro-Wilk test and analyzed with descriptive and inferential statistics. Given that KJOC scores did not follow a normal distribution, we used nonparametric procedures, including independent-samples Mann-Whitney U tests and χ^2 tests of independence. Statistical analyses were performed using SPSS (version 27.0; IBM Corp) and evaluated for significance using a P value of $<.05$.

RESULTS

Participant Demographics and Throwing Arm Injury History

Ninety-six players completed at least 80% of the questionnaire and were therefore included in analyses (Table 1).

Table 1. Demographic Characteristics of Respondents to the Player Questionnaire

Characteristic	No. (%)[a]
Dominant throwing arm	
Right	77 (80.2)
Left	19 (19.8)
Primary position	
Catcher	8 (8.3)
Pitcher	57 (59.4)
First base	3 (3.1)
Second base	4 (4.2)
Third base	3 (3.1)
Shortstop	8 (8.3)
Left field	2 (2.1)
Center field	5 (5.2)
Right field	4 (4.2)
Utility	2 (2.1)
Collegiate division	
National Collegiate Athletic Association	
I	87 (90.6)
II	4 (4.2)
III	1 (1.0)
National Junior College Athletic Association	
I	3 (3.1)
II	1 (1.0)
Total qualifying responses	96
Prior reported injuries	
Glenoid labrum tear	6 (6.3)
Medial ulnar collateral ligament tear	4 (4.2)
Rotator cuff tear	2 (2.1)
Shoulder impingement	2 (2.1)
Growth plate hairline fracture	1 (1.0)
Shoulder subluxation	1 (1.0)
Thoracic outlet syndrome	1 (1.0)
Valgus extension overload	1 (1.0)
Strain, unspecified	1 (1.0)
Epicondylitis	1 (1.0)
Tendinitis, elbow	1 (1.0)
Tendinitis, shoulder	1 (1.0)
Ulnar neuritis	1 (1.0)
Sprain, acromioclavicular joint	1 (1.0)
Axillary neuropathy	1 (1.0)

[a] Except where otherwise indicated.

Approximately 40% (38/96) of responses were gathered during the first half of the CCBL season, whereas the remaining 60.4% (58/96) were recorded during the second half. The mean player age was 20.5 ± 1.2 years. Pitchers accounted for the majority (57/96, 59.4%) of responses. Most athletes (75/96, 78.1%) reported playing only 1 position, whereas the remaining 21.9% (n = 21) of athletes reported playing a second position. Seventy-three of 95 (76.8%) players did not refrain from overhead throwing for at least 2 consecutive months during the prior year. The percentage of players who missed game or practice time in the last year due to a shoulder or elbow injury was 21.9% (21/96). Nearly one-quarter (23/94, 24.5%) of players described being diagnosed with an arm injury other than a strain or sprain. Prior injuries included glenoid labrum tear (n = 6, 6.3%), medial ulnar collateral ligament tear (n = 4, 4.2%), and rotator cuff tear (n = 2, 2.1%). Of the 6 players with labral tears, 1 underwent surgery, and the mean KJOC score for this group was 81.8 ± 19.4, less than the overall mean (86.6 ± 14.5) but not significantly ($P = .467$). Two of the 4 players with ulnar collateral ligament tears underwent ulnar collateral ligament reconstruction, whereas the remaining 2 were treated nonsurgically with platelet-rich plasma therapy; the mean KJOC score for this group of 4 players was 94.8 ± 5.0, greater than the overall mean but not significantly ($P = .235$). The mean KJOC score of the 2 players with rotator cuff tears was 91.0 ± 0.71, also greater than the overall mean but not significantly ($P = .979$); neither athlete underwent surgery. Forty-nine (51.0%) players underwent rehabilitation for an injury to their throwing arm, and 7 (7.3%) experienced a medical procedure. Treatments not yet accounted for included 1 additional player receiving platelet-rich plasma therapy and 1 player undergoing thoracic outlet decompression.

Overall KJOC Scores

The KJOC scores ranged from 29.4 to 100 (Figure). The mean KJOC functionality score among 92 qualifying player responses was 86.6 ± 14.5 (Table 2). The median KJOC score was 90.8 (IQR = 81.6–97.1). Four outlier scores (29.4, 37.0, 49.6, and 53.0) were identified, and the mean KJOC score with outliers removed (n = 88) was 88.6 ± 11.0. The KJOC scores from the first half (n = 35, 88.3 ± 13.4) of the season were not different from those in the second half (n = 57, 85.5 ± 15.1; $P = .336$).

The KJOC scores for specific groups of interest are summarized in Table 3. The 18 (19.6%) athletes with shoulder or elbow injuries resulting in missed playing time over the past year (71.3 ± 20.0) had lower mean KJOC scores than players who were neither injured nor sidelined due to injury (90.3 ± 9.8; $P < .001$). This difference also existed in pitchers (n = 56) alone; those who missed time in the last year due to arm injury (73.8 ± 17.8) had lower mean KJOC scores than pitchers who were not injured and did not miss time (90.3 ± 11.3; $P < .001$). However, the mean KJOC scores of the 13 pitchers with time-loss injuries in the past year (73.8 ± 17.8) did not differ from those of the 5 nonpitchers who missed time due to injury (64.8 ± 26.0; $P = .460$). There was a significant difference between prior treatment type (none, rest, rehabilitation, procedure, or surgery) and KJOC scores converted into binary groups of KJOC ≥ 90 and KJOC < 90 ($P < .001$). More specifically, athletes with no previous treatment for arm injury (n = 41, 88.9 ± 19.0) more frequently demonstrated KJOC scores ≥90 than the 55 players with prior treatment (80.9 ± 17.1; $P < .001$).

Playing With Arm Trouble

In total, 84.4% (81/96) of players indicated they were currently playing without any arm trouble, 14.6% (14/96) were playing but with arm trouble, and only one player (1.0%) was not playing due to arm trouble. Among the 15 players endorsing any type of current arm trouble, 14 (93.3%) completed the survey in the second half of season; of these 15, 8 were pitchers and 7 were nonpitchers. The mean KJOC scores did not differ between pitchers (75.5 ± 15.3) and nonpitchers (67.0 ± 20.0) with current arm trouble ($P = .613$). Overall, the mean KJOC score among all players endorsing current arm trouble was 71.6 ± 17.5, which was lower than the mean of 89.5 ± 11.9 for the 77 players with healthy arms who completed the entire KJOC functionality section ($P < .001$).

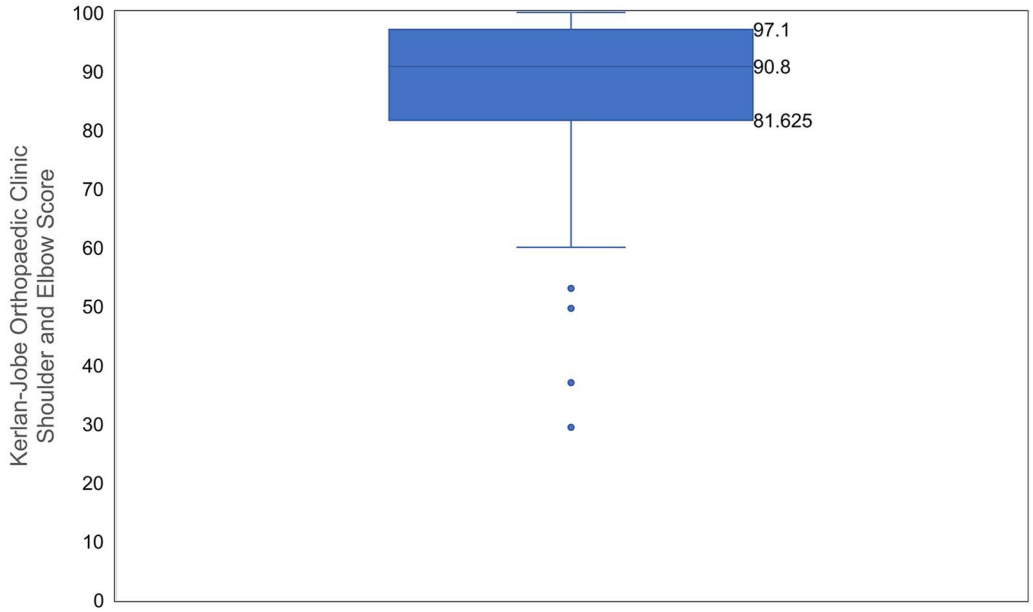

Figure. Box plot depicting Kerlan-Job Orthopaedic Clinic scores (N = 92). Lines in boxes represent the first quartile (81.625), median (90.8), and third quartile (97.1). Whiskers are positioned at the 5th and 95th percentiles, respectively. Individual dots are outlier scores (n = 4), as confirmed by the 1.5 × interquartile range rule.

Other KJOC Comparisons

Although outfield/utility players (82.6 ± 19.7) had lower mean KJOC scores than nonoutfielders (87.1 ± 13.7), the difference was not significant ($P = .406$). The KJOC scores did not vary based on left- versus right-dominant throwing arm ($P = .756$), avoiding or not avoiding overhead throwing for ≥2 months during the past year ($P = .749$), pitchers versus nonpitchers ($P = .734$), catchers and pitchers versus all other positions ($P = .829$), catchers versus pitchers ($P = .253$), age ≥21 years versus age <21 years ($P = .553$), and NCAA Division I college team versus all other divisions ($P = .532$).

Table 2. Kerlan-Jobe Orthopedic Clinic Functionality Scores by Question[a]

Question	Mean ± SD	Range
1. How difficult is it for you to get loose or warm prior to competition or practice?	8.67 ± 1.50	4–10
2. How much pain do you experience in your shoulder or elbow?	7.44 ± 2.98	0–10
3. How much weakness or fatigue (ie, loss of strength) do you experience in your shoulder or elbow?	7.85 ± 2.34	0.7–10
4. How unstable does your shoulder or elbow feel during competition?	8.88 ± 2.12	0.3–10
5. How much have your arm problems affected your relationship with coaches, management, and agents?	9.04 ± 2.36	0.5–10
6. How much have you had to change your throwing motion due to your arm symptoms?	9.07 ± 1.91	2–10
7. How much has your velocity suffered due to your arm?	8.89 ± 1.70	3–10
8. What limitation do you have in competition endurance due to your arm?	8.64 ± 2.26	0–10
9. How much has your control of pitches/throws suffered due to your arm?	8.86 ± 1.88	0.3–10
10. How much does your arm affect your current level of competition in baseball (ie, is your arm holding you back from your full potential)?	9.21 ± 1.35	3–10
Total	**86.6 ± 14.5**	**29.4–100**

[a] The highest possible score is 10.0 for each individual question and 100.0 for the total score; higher scores correspond to greater arm functionality (n = 92 for each question).

DISCUSSION

Cape Cod Baseball League players are elite athletes with rigorous training routines and gameplay schedules. Zachazewski et al, the only earlier group to publish findings from the CCBL population, found that nearly one-quarter of CCBL players had a history of hamstring injury.[18] We similarly hypothesized that approximately 33% of players in our study would report a prior injury. We determined that 24.5% (23/94) of players responded affirmatively to a previously diagnosed arm injury other than a strain or sprain, a value that was less than our hypothesis but still notable.

As both our work and Zachazewski et al's survey have shown, players competing in the CCBL must be monitored closely due to the prevalence of musculoskeletal injuries. Assessing injury epidemiology during the summer season is important to better understand how participation in summer baseball fits into the overall picture of injury incidence and prevention in these high-level athletes.

KJOC Scores in This Study

The mean KJOC score among 92 midseason CCBL players was 86.6 ± 14.5. The mean KJOC scores between players who responded to the survey in the first (88.3 ± 13.4) and second (85.5 ± 15.1) halves of the season did not differ ($P = .336$). Therefore, self-reported arm functionality remained largely the same when comparing responses from the first 50% and second 50% of the season, with no apparent difference based on CCBL gameplay. By contrast, nearly all (14/15, 93.3%) players who endorsed current arm trouble completed

Table 3. Kerlan-Jobe Orthopedic Clinic Scores for Groups of Interest[a]

Group	No.	Score, Mean ± SD (95% CI)	*P* Value
Catcher	8	85.9 ± 15.3 (75.3, 96.5)	—
First base/second base	7	89.6 ± 6.7 (84.6, 94.5)	—
Shortstop/third base	9	88.7 ± 10.4 (81.8, 95.5)	—
Pitcher	56	86.5 ± 14.7 (82.6, 90.3)	.734
Nonpitcher	36	86.7 ± 14.3 (82.0, 91.4)	
Outfield/utility	11	82.6 ± 19.7 (71.0, 94.3)	.406
Nonoutfield/utility	81	87.1 ± 13.7 (84.1, 90.1)	
Prior arm treatment	55	80.9 ± 17.1 (76.5, 85.3)	<.001[b]
No prior arm treatment	41	88.9 ± 19.0 (83.1, 94.7)	
Time-loss injury, past year	18	71.3 ± 20.0 (62.1, 80.5)	<.001[b]
No injury/no time loss, past year	74	90.3 ± 9.8 (88.0, 92.5)	
Time-loss injury, past year, pitchers only	13	73.8 ± 17.8 (64.1, 83.4)	<.001[b]
No injury/no time loss, past year, pitchers only	43	90.3 ± 11.3 (86.9, 93.7)	
Time-loss injury, past year, nonpitchers only	5	64.8 ± 26.0 (42.0, 87.7)	.460
Current arm trouble	15	71.6 ± 17.5 (62.7, 80.4)	<.001[b]
Current healthy arm	77	89.5 ± 11.9 (86.8, 92.1)	
Current arm trouble, pitchers only	8	75.5 ± 15.3 (64.9, 86.1)	.613
Current arm trouble, nonpitchers only	7	67.0 ± 20.0 (52.3, 81.8)	
Left arm dominant	18	88.0 ± 12.0 (82.4, 93.5)	.756
Right arm dominant	74	86.2 ± 15.1 (82.8, 89.7)	
≥2 mo without throwing, past year	22	87.3 ± 13.6 (81.6, 93.0)	.749
<2 mo without throwing, past year	69	86.3 ± 14.9 (82.8, 89.9)	
Age ≥ 21 y	39	87.5 ± 13.7 (83.2, 91.8)	.553
Age < 21 y	53	85.9 ± 15.1 (81.8, 89.9)	
National Collegiate Athletic Association Division I	86	86.2 ± 14.8 (83.1, 89.4)	.532
Non-National Collegiate Athletic Association Division I	6	91.3 ± 6.5 (86.1, 96.4)	

[a] Individual groups are subsets of the pool of all players unless stated otherwise (eg, pitchers only).
[b] Statistically significant result by independent-samples Mann-Whitney *U* test.

the survey during the second half of the season, which may signify that these changes in arm status were acquired specifically during CCBL gameplay. However, future investigation is needed to fully elucidate what proportion of arm trouble is a result of lingering injuries from the collegiate season versus new-onset arm dysfunction or injury owing specifically to participation in summer ball.

Similar to previous authors who used the KJOC Shoulder and Elbow questionnaire, we demonstrated that players reporting current arm trouble (n = 15, 71.6 ± 17.5) or a time-loss arm injury in the past year (n = 18, 71.3 ± 20.0) had lower KJOC scores than players with currently healthy arms (n = 77, 89.5 ± 11.9) and healthy arms throughout the prior year (n = 74, 90.3 ± 9.8; $P < .001$ for both).[19–21] Conversely, athletes with no earlier treatment for an upper extremity injury more frequently displayed KJOC scores ≥90 ($P < .001$). This trend was also seen at a position-specific level, as pitchers with time-loss injuries in the past year had lower KJOC scores than pitchers with no injury or time loss ($P < .001$). These findings suggest that elite athletes in the CCBL continue to carry the burden of previous injuries into the summer league season and perhaps require more rehabilitation time given the athletic demands of baseball on the upper extremity. This concept of previous pain and injury influencing future KJOC scores has been established in studies examining high school and collegiate athletes.[22–24] For this reason, physicians, ATs, and other health care providers may consider additional monitoring for summer league athletes with prior injuries even in the absence of current impairment.

Comparison of KJOC Scores With Previous Research

The KJOC scores we identified were similar to those reported in studies of college ballplayers. For example, Wilkins et al observed a median KJOC score of 90.5 among nearly 300 collegiate baseball players, on par with our median of 90.8.[25] Croci et al described a median KJOC between 72.5 and 87.2 depending on the degree of early sport specialization among 129 collegiate players.[7] Similarly, Chasse et al reported a mean KJOC score among 21 uninjured pitchers of 86.8 ± 12.1, whereas mean scores for injured pitchers ranged from 74.2 ± 22.6 (n = 9) to 89.9 ± 9.0 (n = 6) depending on surgical or nonsurgical treatment.[26] These values are consistent with our corresponding mean KJOC scores: 71.6 ± 17.5 and 89.5 ± 11.9 for players with current arm trouble (n = 15) and the remaining players with healthy arms, respectively.

However, because many CCBL players continue their baseball careers at the professional level, it is notable that the mean KJOC score in CCBL athletes was considerably lower than that of professional ballplayers. For example, in a 2013 analysis, the mean KJOC score was 94.8 ± 6.4 among 44 asymptomatic Minor League Baseball (MiLB) pitchers. The research group proposed that a score of ≥90 should be considered *normal* and that scores <90 are cause for concern in healthy professional pitchers.[27] A 2011 to 2012 survey of 203 MLB and MiLB players showed that MLB players with no history of upper extremity injury had a mean KJOC score of 97.1 ± 4.6, and uninjured MiLB participants had a mean score of 96.8 ± 4.3. Interestingly, players with a history of injury had a mean score of 86.7, which was similar to the overall mean for our CCBL athletes.[21] Finally, Fronek et al assessed 366 MiLB pitchers and found the mean KJOC score to be 92.8 ± 12.1, with pitchers who did not receive treatment within the past year having a higher score than their counterparts, as we also described.[19]

Taken together, data from prior studies indicated that the mean KJOC score among CCBL players was comparable with scores among other collegiate (although not summer league specific) baseball players but lower than scores of professional pitchers. Even with the 4 outlier scores removed, our mean KJOC score was still <90. We believe this evidence is sufficient to refute our hypothesis that throwing arm functionality in CCBL players would be comparable with that of professional players. Our population was an average of only 1.4 years younger than the 2022 mean age for pitchers at the Low-A professional level.[28] Because CCBL players are similar in age to surveyed MiLB players who reported higher average KJOC scores, one potential explanation for the score discrepancy could be underlying self-selecting bias, in which only players with top arm health advance from high-level collegiate baseball to professional baseball. Future investigators could determine whether the relative arm dysfunction among CCBL players

persists or is self-limited and specific to the time point of data collection featured herein. To do so, readministration of the KJOC questionnaire to CCBL players at the end of the summer season, during the offseason, and at age 22 or over for players who advance to professional ball would be valuable.

Position-Specific KJOC Scores

Baseball features a wide variety of physical demands from position to position, and thus, we may expect overuse injuries to be more common in certain positions. Pitchers and catchers had the highest rates of upper extremity injuries compared with other positions, likely due to the high volume of throwing required.[29,30] Lower KJOC scores were demonstrated among pitchers and infielders versus outfielders and catchers.[21] However, we did not detect any significant differences in KJOC scores among positions. For example, although outfield/utility players had lower mean KJOC scores (82.6 $\pm$ 19.7) than nonoutfielders (87.1 $\pm$ 13.7), the difference was not significant ($P = .406$). Additionally, pitchers (86.5 $\pm$ 14.7) and nonpitchers (86.7 $\pm$ 14.3) had nearly identical mean KJOC scores. Identifying exactly why our pitchers posted average KJOC scores no different than position players is beyond the scope of this paper and a potential direction for future research. However, one methodologic explanation could be detection bias, as perhaps a higher proportion of less functional, more injured pitchers and catchers refused to participate in our study, precluding us from observing the true difference in KJOC score (if any) among these positions.

Exploring Additional Risk Factors for Injury

More than three-quarters (73/95, 76.8%) of players in our survey engaged in overhead throwing for $\geq$10 months during the prior year. Despite reports linking injured cohorts to more months per year of overhead throwing, we did not find a difference in KJOC scores based on avoiding or not avoiding overhead throwing for $\geq$2 months ($P = .749$).[31] Training-related factors that may be associated with an increased risk for arm injury but were not explicitly assessed in this survey include early sport specialization and training with weighted baseballs.[7,32]

Limitations

Although this is the first study of arm injuries in the CCBL, our work had limitations. As in the original publication of the KJOC questionnaire, the term *injury* was not specifically defined for participants; this means we generally could not distinguish between time-loss and non–time-loss injuries.[16] Also, the player turnover rate in the CCBL is high. Players are activated and released from team rosters daily for reasons including health, alternative commitments, and performance. Each of the 10 CCBL teams often cycles through nearly 60 players during the summer season. However, only approximately 30 active players are on each roster at any given time. For this reason, and to maintain confidentiality, we could not link the league status of each player with the data reported on our questionnaire. The responding players likely participated in different numbers of games, which may have affected arm symptoms. Additionally, due to the sheer volume of players cycling through teams, perhaps for only 1 or 2 games, it was not possible to obtain responses from some of these players. Injury rates may have skewed lower than their true values because injured players were sometimes released. This limitation was further complicated by the possibility that players transitioning to or from a CCBL team may be intentionally escalating or decreasing their throwing workload based on their roster status, possibly influencing their reported arm functionality. Similarly, regular performance in front of MLB scouts may encourage players to intentionally adjust their performance, such as throwing different pitches or pitching more or less, thereby affecting perceived arm functionality. Furthermore, despite the survey collection period occurring at the end of the annual competitive baseball cycle (which extends from the start of collegiate baseball in February to the conclusion of summer ball in August), the relatively wide survey administration period posed the risk for different results based on the time point of survey completion. Another factor was the considerable data variability, as evidenced by an SD of 14.5. Additional research is needed to elucidate a more precise mean KJOC score among collegiate summer league baseball players. Finally, we were uncertain as to why outfielders reported the lowest KJOC scores compared with other positions despite previous studies demonstrating this finding primarily in pitchers.[21,29,30]

CONCLUSIONS

This survey is the first, to our knowledge, to evaluate upper extremity injuries among baseball players participating in a summer collegiate league. The CCBL is one of the nation's premier collegiate summer baseball leagues and has historically been considered a stepping stone toward professional baseball. Our results suggest that CCBL athletes' baseline KJOC scores were comparable with those of other collegiate players but lower than those of professional players, particularly if a history of injury existed. Attention to the injury history and current risk factors may reduce the risk for new or repeat injuries during summer baseball league play. This information provides valuable insight to players, coaches, and health care providers about a population with the potential to play professional baseball. Our findings further indicate that arm health should be diligently monitored by athletes and ball clubs alike to optimize performance and longevity for the athletes. Future directions include investigations into the incidence of AT-reported in-season injuries and longer-term follow-ups to determine how these findings may affect a player's highest level of achievement.

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