Upper Extremity Injury History, Current Pain Rating, and Health-Related Quality of Life in Female Softball Pitchers

Eric L. Sauers, Danelle L. Dykstra, R. Curtis Bay, Kellie Huxel Bliven, and Alison R. Snyder

Context: Throwing-related arm injuries are common in softball pitchers and may lead to diminished health-related quality of life (HRQOL). Arm symptoms such as pain have been reported to be more common in healthy overhead athletes than nonoverhead athletes. Furthermore, more frequent shoulder symptoms and lower shoulder function have been demonstrated in athletes with self-reported history of shoulder injury. Objective: To evaluate the relationship between arm injury history, current pain rating, and HRQOL assessed via 2 region-specific patient self-report scales in high school and college softball pitchers. Design: Cross-sectional. Setting: High school and college athletic training facilities. Participants: 25 female softball pitchers (10 high school, 15 college; 18 ± 2 y, 169 ± 7.6 cm, 67.5 ± 10.3 kg). Intervention: Self-reported arm injury history and rating of current pain and HRQOL were collected during the late season. Main Outcome Measures: A self-report questionnaire of arm injury history and current pain rating was used, and HRQOL was assessed via 2 region-specific scales: the Disabilities of the Arm, Shoulder, and Hand (DASH) and the Functional Arm Scale for Throwers© (FAST©). Correlational analysis was used to evaluate the relationships between arm injury history, current pain rating, and the DASH total score and sport module and the FAST total score, pitching module, and subscales. Results: A history of arm injury from throwing was reported by 64% of participants, 31% of whom had to cease activity for more than 10 d. The most common site of arm time-loss injury was the shoulder (81%). Mild to severe shoulder pain during the competitive season was reported by 60% of respondents. The DASH and the FAST total scores were significantly correlated (r = .79, P < .001). Respondent rating of shoulder pain correlated significantly with the DASH total (r = .69) and sports module (r = .69) and the FAST total (r = .71), pitching module (r = .65), and pain (r = .73), impairment (r = .76), functional-limitation (r = .79), disability (r = .52), and societal-limitations (r = .46) subscales. Conclusion: History of arm injury is common in female high school and college softball pitchers. Severe injury and elevated pain are associated with lower HRQOL that extends beyond the playing field.

Keywords: self-report, disability, HRQOL, DASH, FAST

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Softball has increased in popularity among female athletes. Despite the growing popularity of the sport, little is known regarding the incidence of injuries to the arm from repetitive throwing in softball. Overuse injuries are of concern in both softball and baseball despite the differences in pitching delivery. Upper extremity injuries account for most injuries reported by softball and baseball players, particularly pitchers. An alarming 82% of youth baseball pitchers report musculoskeletal injury in the shoulder and elbow. Hill et al classified injuries in softball pitchers for 1 season and reported that most were to the upper extremity and included tendinitis in the shoulder, elbow, or wrist.

Chronic upper extremity injuries in softball are attributed to the repetitive nature of pitching, which places extreme forces through the shoulder and elbow. Several kinetic and kinematic factors at the shoulder and elbow may contribute to injury through the 6 phases of the windmill pitch. The angular velocity of the shoulder during the windmill pitch has been reported to be as high as 2190° ± 583°/s with peak compressive forces reaching 80% ± 22% of body weight. The elbow achieves speeds as high as 1248° ± 431°/s and a maximum compressive force of 61% ± 19% of body weight during the windmill pitch. Considering the high number and type of pitches thrown, often over 80 pitches per game, the throwing arm—particularly in younger athletes—is at risk for injury.

Previous research has demonstrated that college athletes are expected to experience a variety of shoulder symptoms during training and competition at midseason and that the absence of shoulder symptoms in noninjured competitive athletes is unusual. In addition, healthy overhead athletes have reported significantly lower shoulder function and greater presence of symptoms such as pain than nonoverhead athletes. A previous history of upper extremity injury has also been shown to result in greater pain scores and lower classification of shoulder function using multiple self-report upper extremity scales. Therefore, even though an athlete is actively participating and considered to be noninjured during their sport season, he or she may be experiencing pain or other symptoms during participation.

Several studies have demonstrated that high school and college athletes suffering from sport-related injuries report lower health-related quality of life (HRQOL) than noninjured athletes. HRQOL “refers to the physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person’s experiences, beliefs, expectation, and perceptions.” The importance of assessing patient-oriented outcomes and HRQOL in a disablement framework in sport rehabilitation has been emphasized, but this has been poorly studied in athletic populations. It is possible that overuse or a discrete injury related to routine participation as a competitive softball pitcher could lead to diminished HRQOL as the result of pain, weakness, soreness, loss of function, and subsequent inability to fully participate in sport and desired activities of daily living. Given the large demands placed on the softball pitching shoulder and the prevalence of overuse injuries in these athletes, the relationships between injury history and current pain rating and HRQOL are of interest. However, the relationships between self-reported injury history, current rating of pain, and upper extremity symptoms and disability assessed via region-specific instruments have not been examined in female softball pitchers.

Therefore, the purpose of this study was to evaluate the relationships between upper extremity injury history, current pain rating, and HRQOL assessed via 2
region-specific patient self-report scales in high school and college softball pitchers. We hypothesized that patients with self-reported history of upper extremity injury and greater pain scores in the upper extremity would report lesser HRQOL.

Methods

Subjects

All subjects signed an informed-consent form approved by an institutional review board before participation. Subjects under the age of 18 required a parent or guardian’s signature to participate. Female softball pitchers recruited for participation in the study were between the ages of 14 and 23 years, participating in a high school or college softball league, and without a current injury or illness preventing their full participation in softball. Subjects had been actively participating in competitive softball for no less than the previous month of the season and must have pitched on average at least once per week during this time. Pitchers who had not been consistently active over the past month or who reported that a current illness or injury prevented their participation were excluded from the study.

Instrumentation

*Upper Extremity Injury History and Current Pain-Rating Questionnaire.* Subjects completed an upper extremity injury questionnaire that asked for demographic information, as well as questions regarding history of previous upper extremity injury and current pain rating for the upper extremity. They were asked the following questions pertaining to their injury history:

• Have you ever had an injury from throwing that caused you to miss at least 1 day from practice or games but less than 10 days?
• Have you ever had an injury from throwing that caused you to miss 10 or more days from practice or games?
• Have you had an injury in the past 3 months that has prevented you from throwing?

Injuries that were reported to have caused 10 or more days of lost participation were considered severe for the purposes of this study. This definition was chosen to be consistent with the definitions used by the National Collegiate Athletic Association (NCAA) Injury Surveillance System. If the subjects noted any injury history, they were asked to identify where in the upper extremity the injury or injuries occurred (shoulder, elbow, wrist, or hand).

Current level of upper extremity pain was rated for the arm, shoulder, elbow, wrist, and hand. For each region, subjects were asked to categorize their current pain level from 1 (no pain) to 5 (unable to throw).

*Disabilities of the Arm, Shoulder, and Hand.* The Disabilities of the Arm, Shoulder, and Hand scale (DASH) is a 30-item scale, with a separate optional work module and sports/performing arts (sport) module, that measures physical function and symptoms of acute and chronic upper extremity musculoskeletal conditions. We used the DASH total scale and sport module to measure upper
extremity symptoms and disability and to serve as a valid measure of HRQOL. The total scale and the sport module are each scored separately on a 100-point scale, with higher scores indicating greater symptoms and disability and lower HRQOL. The DASH consists of questions that relate to physical function (eg, ability to place an object on a shelf above your head, write, and make your bed), symptoms (eg, pain and stiffness in your arm, shoulder, or hand), and social/role function (eg, interference with normal social activities, level of confidence, and usefulness). The 4-question sport module includes items to assess the impact of the patient’s upper extremity problem on playing his or her musical instrument or sport, or both (eg, ability to play a musical instrument or sport as well as you would like and ability to spend the usual amount of time practicing or playing your instrument or sport). Responses are tabulated to calculate a DASH total score and sports-module score. The DASH is a widely used region-specific upper extremity patient self-report scale that has demonstrated acceptable measurement properties for test–retest reliability, internal consistency, and content, construct, and discriminant validity.

Functional Arm Scale for Throwers©

We have developed a new region-specific patient self-report scale for the assessment of arm injuries in throwing athletes called the Functional Arm Scale for Throwers (FAST©). The FAST was included in this study as a second region-specific patient self-report scale, in addition to the DASH, because it was developed to assess HRQOL in high-demand throwers. Hsu et al compared DASH scores from the general population with those of over 300 healthy athletes from 20 different sports and found that athletes reported significantly higher shoulder function, which causes substantial ceiling effects, thereby limiting the instrument’s validity when used with intercollegiate athletes. The FAST was developed for use with athletes to assess 4 of the disablement domains defined by the National Center for Medical Rehabilitation Research, which include impairment, functional limitations, disability, and societal limitations. Although pain is generally classified as an impairment, a separate pain subscale was developed for the FAST to enable comparison with other scales with distinct pain subscales. Collectively, these 5 subscale domains (pain, impairment, functional limitation, disability, and societal limitation) enable global assessment of HRQOL using a single scale that contains both sport-related and non-sport-related questions. The total scale and 5 subscales are each scored separately on a 100-point scale, with higher scores indicating greater symptoms and disability and lower HRQOL. The beta version of the FAST used for this study (see Appendix) is a 54-item scale, plus a 9-item pitcher module, with questions that are classified as follows: pain = 11 (6 sport-related and 5 non-sport-related), impairment = 16 (8 sport-related and 8 non-sport-related), functional limitation = 14 (12 sport-related and 2 non-sport-related), disability = 15 (10 sport-related and 5 non-sport-related), and societal limitation = 7 (1 sport-related and 6 non-sport-related). The initial scale was developed using a sound empirical process of item generation, item reduction, item importance assessed by an expert panel, and item interpretability. However, caution should be used when interpreting data from the FAST because the measurement properties for this instrument have not yet been established.

Procedures

Study packets were mailed to the athletic trainer at participating high schools and colleges at the beginning of their interscholastic or intercollegiate softball season.
The packet included consent and assent forms with a brief description of the study, an upper extremity injury history and current pain-rating questionnaire, the DASH, the FAST, and prepaid return envelopes. Each packet was individually marked, and a key was maintained by the primary investigator to ensure that all data forms were coded to the same subject and each packet was retrieved from each school. No personal identifiers were included on any of the data-collection forms.

The consent forms were distributed to all the softball pitchers and collected during late season, defined as week 8 to week 12 of the competitive interscholastic or intercollegiate softball season, by each school’s athletic trainer. The pitchers completed each of the data forms (upper extremity injury history and current pain-rating questionnaire, DASH, and FAST) before practice at a point during the late season. Each school’s athletic trainer collected the forms and mailed them back to the primary investigator, who maintained regular contact to encourage participation and complete data collection.

Data Analyses

Summary statistics were calculated for upper extremity injury history, current pain rating, the DASH total score and sport module, and the FAST total score, pitching module, and subscales. Spearman’s rho or point-biserial correlations were used, as appropriate, to evaluate the relationships between injury history and current pain rating, the DASH, and the FAST. For the purposes of this study all correlation coefficients were interpreted as follows: .00–.25 = little, if any, correlation; .25–.50 = fair correlation; .50–.75 = good correlation; and >.75 = good to excellent correlation.30 Mann–Whitney tests were used to compare differences across groups.

Subscale scores were calculated for the DASH based on the developers’ instructions.23 Subscale scores were calculated for the FAST based on a theoretically derived structure that is identical to the scoring of the DASH. Mann–Whitney tests were used for group comparisons. Statistical significance for all tests was set at $P \leq .05$, 2-tailed. Data were analyzed using PASW, version 18 (SPSS, Inc, Chicago, IL).

Results

Twenty-five female high school and college softball pitchers volunteered to participate in this study. Subject demographics are provided in Table 1. Data on upper extremity injury history by site of injury and respondent are provided in Table 2. (Some respondents experienced injuries at more than one site, so total sites of injury does not sum to number of athletes injured.) Sixty-four percent (16/25) of respondents reported a history of upper extremity injury from throwing that caused them to miss 1–9 days from practice or games (less severe); 20% (5/25) reported a history of upper extremity injury from throwing that caused them to miss 10 or more days (severe). Furthermore, 20% (5/25) reported an upper extremity injury from throwing in the past 3 months that had prevented them from throwing. Among the 16 respondents reporting time-loss upper extremity injuries across the 3 levels of severity, the most commonly reported site of injury was the shoulder (81%, 12/16). Data on current rating of upper extremity pain are summarized in Table 3. Sixty percent (15/25) of respondents reported mild to severe shoulder pain at rest during the competitive season. DASH and FAST scores are summarized in
Twelve respondents reported injuries to the shoulder that caused 1–9 days missed from practice or games (less severe). The FAST impairment subscale was moderately correlated ($r = .43, P < .05$) with the presence of less severe (<10 d) injuries.
shoulder injuries. Five injuries to the shoulder caused 10 or more days missed from practice or games (severe). The FAST pitching module \((r = .58, P < .01)\) and FAST impairment \((r = .46, P < .05)\), functional-limitations \((r = .50, P < .05)\), disability \((r = .55, p < .01)\), and societal-limitations \((r = .45, P < .05)\) subscales were all moderately correlated with self-reported history of severe shoulder injury.

Correlations between DASH and FAST scores and current pain rating (Table 6) are also provided.

Participants who reported mild to severe shoulder pain (15/25) had elevated scores, indicating lesser HRQOL, on the FAST total, FAST pitching module, and FAST pain, impairment, and functional-limitation subscales, as well as the DASH total score \((P < .05; Table 7)\).

Discussion

This study examined the relationships between self-reported upper extremity injury history, current rating of pain, and HRQOL in competitive softball pitchers. Our primary finding was that a history of upper extremity injury and pain is common among competitive female softball pitchers and that reports of elevated upper extremity pain in competitive female softball pitchers are associated with lower HRQOL.
Table 6  Correlations Between Current Pain Rating and the DASH and FAST©

<table>
<thead>
<tr>
<th>Location</th>
<th>DASH</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Sport module</td>
<td>Total</td>
<td>Pitching module</td>
<td>Pain</td>
<td>Impairment</td>
<td>Functional limitations</td>
<td>Disability</td>
<td>Societal limitations</td>
<td></td>
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<tr>
<td>Arm</td>
<td>.56**</td>
<td>.56**</td>
<td>.42</td>
<td>.34</td>
<td>.51*</td>
<td>.26</td>
<td>.49*</td>
<td>.033</td>
<td>−.23</td>
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<tr>
<td>Shoulder</td>
<td>.69**</td>
<td>.69**</td>
<td>.71**</td>
<td>.65**</td>
<td>.73**</td>
<td>.76**</td>
<td>.79**</td>
<td>.52*</td>
<td>.46*</td>
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<tr>
<td>Elbow</td>
<td>.58**</td>
<td>.73**</td>
<td>.62**</td>
<td>.50*</td>
<td>.57**</td>
<td>.51*</td>
<td>.49*</td>
<td>.30</td>
<td>−.07</td>
<td></td>
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<tr>
<td>Wrist</td>
<td>.38</td>
<td>.29</td>
<td>.05</td>
<td>.40</td>
<td>.08</td>
<td>.47*</td>
<td>.50*</td>
<td>.29</td>
<td>.56**</td>
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</tr>
<tr>
<td>Hand</td>
<td>−.005</td>
<td>.006</td>
<td>.01</td>
<td>.10</td>
<td>−.08</td>
<td>.02</td>
<td>.05</td>
<td>−.04</td>
<td>−.12</td>
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*P < .05. **P < .01.
Although 64% of pitchers reported missing 1–9 days of participation, an alarming 20% reported missing 10 or more days. We found that all injuries resulting in 10 or more days of missed practice or competition were the result of a shoulder injury. The percentage of pitchers reporting a severe upper extremity injury in our small sample is much larger than that reported by the 15-year NCAA surveillance study in softball, which combined data from both pitchers and positional players. Note that Marshall et al\(^3\) reported that, during games, only 12.7% of severe injuries were to the upper extremity (6.5% hand and 6.2% finger), and during practices only 5.5% of severe injuries were to the upper extremity (shoulder = 5.5%). Despite these relatively low percentages of severe injuries, the NCAA softball study reported that when all injuries were accounted for, 33.1% of game and 33.0% of practice injuries were to the upper extremity.\(^3\) For both games and practices, the shoulder was the most frequently injured upper extremity body part, accounting for 5.8% of all game injuries and 11.3% of all practice injuries.\(^3\)

Two other smaller studies have also reported much higher percentages of shoulder injuries in college softball pitchers than the NCAA survey data. Hill et al\(^5\) reported that a very high percentage of pitchers suffered an injury (72.8%, 131/180), of which 60 had chronic or overuse injuries to the upper extremity (6.5% hand and 6.2% finger), and during practices only 5.5% of severe injuries were to the upper extremity (shoulder = 5.5%). Despite these relatively low percentages of severe injuries, the NCAA softball study reported that when all injuries were accounted for, 33.1% of game and 33.0% of practice injuries were to the upper extremity.\(^3\) For both games and practices, the shoulder was the most frequently injured upper extremity body part, accounting for 5.8% of all game injuries and 11.3% of all practice injuries.\(^3\)

We found that 60% of pitchers (15/25) reported mild to severe upper extremity pain late in their competitive season. Use of nonsteroidal anti-inflammatory (NSAID) medication may be an indicator of the presence of inflammation or pain. Two studies have reported NSAID use by softball pitchers evaluated throughout an entire season to range from 46%\(^1\) to 83%.\(^5\) Loosli et al\(^1\) also reported the frequency of NSAID use before or after practice and found that 72% of pitchers used NSAIDs

<table>
<thead>
<tr>
<th>Table 7</th>
<th>FAST© and DASH Scores in Subjects With and Without a History of Shoulder Pain, Mean ± SD</th>
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<tbody>
<tr>
<td>No pain (n = 10)</td>
<td>Mild to severe pain (n = 15)</td>
</tr>
<tr>
<td>FAST total score</td>
<td>3.0 ± 2.7</td>
</tr>
<tr>
<td>FAST pitching module</td>
<td>3.3 ± 5.5</td>
</tr>
<tr>
<td>FAST pain</td>
<td>4.3 ± 4.9</td>
</tr>
<tr>
<td>FAST impairment</td>
<td>4.1 ± 4.8</td>
</tr>
<tr>
<td>FAST functional limitations</td>
<td>2.9 ± 4.1</td>
</tr>
<tr>
<td>FAST disability</td>
<td>1.5 ± 2.2</td>
</tr>
<tr>
<td>FAST societal limitations</td>
<td>1.4 ± 3.5</td>
</tr>
<tr>
<td>DASH total score</td>
<td>2.5 ± 3.5</td>
</tr>
<tr>
<td>DASH sport module</td>
<td>4.7 ± 5.5</td>
</tr>
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</table>

\(*P < .05. **P < .01.\)
both before and after. Soldatis et al. reported that 47% of “healthy” college athletes reported shoulder pain at midseason, despite full sport participation. Collectively, these findings suggest that female softball pitchers who are fully participating in their sport are regularly experiencing pain in the throwing arm during the competitive season. Therefore, after rehabilitation from injury, it may not be realistic to return competitive softball pitchers to participation with the expectation that they will be pain free with repetitive pitching. This finding is particularly important given the fact that research has demonstrated that college athletes who experience injury and pain will experience physical limitations during exercise later in life. Whole-person health care involves the provision of health care services that extend beyond pathophysiology and impairment through the assessment and treatment of functional limitations, disability, and societal limitations. Patient self-report instruments such as the DASH and the FAST serve as tools for clinicians to assess patient-oriented measures across the entire spectrum of HRQOL. Using patient self-report scales, researchers have demonstrated that adolescents who regularly participate in organized sport have a higher HRQOL than their peers who do not regularly participate in sport. However, data from the same study population revealed that a history of sport-related injury in adolescent athletes is associated with lower HRQOL, specifically in the domains of physical functioning and pain, as well as social function. Collectively, these findings demonstrate that despite the positive association of adolescent sport participation with HRQOL, the negative impact of sport-related injury on HRQOL must be considered, as well. In our study, female softball pitchers who experienced mild to severe shoulder pain scored significantly higher on the DASH and FAST scales and subscales (Table 7), indicating lesser HRQOL. This finding suggests that routine assessment of patient-centered measures is important to identify subgroups such as softball pitchers with shoulder pain who may be experiencing diminished physical or mental health as a result of pain and injury related to their sport participation. In these instances, intervention strategies or close monitoring may be necessary to maintain overall health status or prevent the progression of pain or soreness into occult injury.

Intercollegiate athletes have been shown to exhibit significantly greater shoulder function than the general population using the DASH. In addition, overhead athletes exhibited significantly higher DASH total and sports-module scores than nonoverhead athletes, indicating a lower HRQOL for those involved in overhead sports. Soldatis et al. found that healthy intercollegiate athletes with a history of shoulder injury reported significantly greater current pain-rating scores using multiple upper extremity self-report scales. Those with a previous shoulder injury also more frequently self-reported fair or good shoulder function compared with excellent shoulder function in noninjured athletes when scored using the Rowe and Constant-Murley scales. In contrast to both our current findings and those previously reported by Soldatis et al., Hsu et al. found no statistically significant difference in DASH total or sport-module scores between athletes with and without a previous history of upper extremity injury. Further study of the impact of previous upper extremity history on HRQOL in overhead athletes is clearly warranted.

Injury severity, defined according to the number of days of missed participation (severe = 10 or more d of time loss), was correlated with FAST subscale scores but was not correlated with the DASH. Softball pitchers with shoulder injuries who self-reported more severe injuries also had higher FAST subscale scores than those
with less severe shoulder injuries (<10 d), indicating lesser HRQOL. Furthermore, the positive relationship between injury severity and FAST scores was apparent across more subscales in softball pitchers out of participation 10 or more days (FAST pitching module and FAST impairment, functional-limitations, disability, and societal-limitations subscales) than pitchers who missed <10 days (FAST impairment). Our results are consistent with research on psychological and mood states after injury. Previous research has reported more mood disturbances such as increased depression and tension and lower self-esteem and vigor in athletes with more severe injuries that remove them from participation for long time periods.34,35 These findings demonstrate the impact of time loss on competitive athletes’ psychological well-being and overall HRQOL. Considering these previous research studies in competitive athletes, the findings in our current study suggest that the FAST may be a practical tool for clinicians to use to assess and monitor HRQOL in throwing athletes.

Current rating of upper extremity pain in softball pitchers was correlated with both DASH and FAST scores (Table 6). The strongest correlations were at the shoulder and elbow, which were also the locations for which softball pitchers self-reported experiencing more injuries and missed participation because of injury and pain. The correlations between pain and DASH and FAST scores ranged from fair to excellent (r = .46–.79; Table 6), indicating that more severe pain is related to elevated scores and lower HRQOL. For shoulder pain, the strongest correlations (r ≥ .70) were with the FAST total and FAST pain, impairment, and functional-limitation subscales (Table 6). Although fully participating in their sport, 60% (15/25) of the softball pitchers self-reported mild to severe shoulder pain that negatively affected their HRQOL (Table 7). Previous research on psychological responses to injury suggests pain as a primary mediator affecting one’s perceptions of recovery from injury, therefore affecting one’s overall well-being.36 Clinicians should be aware of the impact of pain on an athlete’s overall well-being and consider strategies to monitor or improve athletes’ HRQOL when appropriate.

For elbow pain, the strongest correlation (r ≥ .70) was with the DASH sport module; however, fair to good correlations (r = .49–.62) were found for the DASH total, FAST total, FAST pitching module, and FAST pain, impairment, and functional-limitation subscales. Previous research examining HRQOL in patients with elbow injury reported increased pain, decreased function, and psychological disturbances in those with tennis elbow compared with healthy controls.37 Collectively, these findings demonstrate how pain may extend beyond impairment to affect an individual’s overall HRQOL and suggest that, in athletes with pain, a strategy for assessing whole-person health care is warranted.

There were fair to good correlations between pain at the wrist and FAST impairment, functional-limitation, and societal-limitation subscales (Table 6). Comparison of DASH and FAST scores and pain in the hand revealed little, if any, relationship. Most pitchers (88%) reported no pain in the hand, and this lack of variability in the data may explain the low correlations observed.

This was the first study to assess HRQOL in female softball pitchers using upper extremity patient self-report scales. Overall, DASH and FAST scores were low (Table 4), suggesting a high HRQOL despite a history of throwing-related upper extremity injury or the presence of upper extremity pain. However, the range of scores was wide, demonstrating a subset of athletes with high scores and lower
HRQOL (Table 4). The subset of pitchers (n = 15/25) who reported mild to severe pain had significantly higher DASH total and pitching-module scores and FAST scores (total, pitching module, pain, impairment, and functional limitation) than those reporting no pain (Table 7). These findings demonstrate the role of pain in an individual’s well-being beyond the injury, and implementing strategies to reduce pain may have widespread implications such as improving HRQOL.

The DASH has been shown to have acceptable measurement properties for use in the general population. However, it was not developed for use with high-functioning individuals such as competitive softball pitchers, which may limit the scale’s ability to detect clinically meaningful changes in these athletes’ HRQOL. The DASH has recently been reported to suffer from substantial ceiling effects, thereby limiting the scale’s validity when used with intercollegiate athletes, who demonstrate significantly greater shoulder function than the general population. The FAST was developed specifically to assess the impact of upper extremity throwing-related injuries on an athlete’s HRQOL. Theoretically, DASH and FAST scores should be related because they are both region-specific upper extremity scales that include questions pertinent to domains of the disablement model. All the DASH and FAST scores in our study were significantly correlated, with most of these correlations in the good to excellent range (Table 5). The good to excellent correlations observed between these 2 scales provide preliminary evidence for concurrent validity of the FAST when compared with a well-validated instrument such as the DASH. Clearly, though, the FAST and DASH are not redundant. Exploratory analyses of the measurement properties of the FAST revealed higher FAST scores, suggesting lesser HRQOL, in those with a history of severe injury (ie, injury resulting in 10 or more d of time loss from sport participation). This finding suggests that the FAST may be sensitive enough to detect associated changes in HRQOL in those with a history of severe injury. Furthermore, both the FAST and DASH were sensitive enough to differentiate between softball pitchers with a current history of shoulder pain and those without. Measurement properties of the FAST, including reliability, standard error of measurement, and minimum detectable change, have not yet been estimated, so statements regarding scale properties are tentative and should be interpreted in this way. We have collected data on over 300 baseball and softball players with and without upper extremity throwing-related injuries and are analyzing those now to further develop the FAST.

There are several limitations of this study. First, we studied a convenience sample of competitive softball athletes, so our results cannot be generalized beyond this study. Furthermore, data from this small sample lacked variability, which truncated the range of the data and may have limited our ability to detect relationships between variables of interest. Finally, caution should be used when interpreting FAST scores because it is a newly developed instrument and its measurement properties are not yet established.

Conclusions

These data from a small convenience sample suggest that upper extremity injuries and pain are common among competitive female softball pitchers. Reports of elevated upper extremity pain in competitive female softball pitchers are associated
with lesser HRQOL that extends beyond the playing field. These data suggest that
the FAST is capable of capturing accurate HRQOL data in high-demand throwing
athletes using a disablement framework. Measurement properties of the FAST are
currently being assessed. Further research examining the impact of repetitive softball
pitching on upper extremity injury, pain, and HRQOL is warranted.

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tion of the data and drafting, critical revision, and final approval of the manuscript. Alison
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approval of the manuscript.

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