

Differences in the Medical Advisability of Online Pitching Recommendations for Youth Softball Players Based on Website Source

David F. Painter,* BS, Rory A. Byrne,[†] BS, James H. Dove,^{†‡} MD, Yang Lin,* BS, and Brett D. Owens,[†] MD

Investigation performed at The Warren Alpert Medical School, Brown University, Providence, Rhode Island, USA

Background: Guidelines regarding injury prevention in fast-pitch softball pitchers have yet to be widely adopted, risking the online dissemination of misleading advice.

Purpose/Hypothesis: The purpose of this study was to assess the source and medical advisability of online pitching recommendations for youth softball players and highlight the risk of misinformation. It was hypothesized that many popular websites would contain content discordant with current medical guidelines regarding windmill softball pitching recommendations.

Study Design: Cross-sectional study.

Methods: A Google search using the phrase “youth softball pitching recommendations” was performed. Up to 100 websites were extracted and analyzed for website source type (commercial, medical/educational, or athletic organization) and informational quality (advisable, neutral, or discordant). The latter was determined with respect to the STOP Sports Injuries guidelines for arm injury prevention in youth softball players. Descriptive and inferential statistics were used to assess potential associations between website source type and the informational quality of content therein.

Results: A total of 86 websites were included in the analysis. Website source type was significantly predictive of informational quality ($P = .018$). Among the 3 source types, medical/educational websites had the highest proportion classified as advisable (12/24 [50.0%]) and the lowest proportion classified as discordant (3/24 [12.5%]). Only 17.6% (6/34) of commercial websites were advisable, and advisable websites as a whole were more likely to be from medical/educational sources than athletic organization ($P = .016$) or commercial ($P = .026$) sources. The advisability rate among all websites was 25.6% (22/86). Although there was a significant association between position in the search results (first 10 vs remaining 76) and website source type ($P = .006$), there was no association between position and informational quality ($P = .116$). The first 10 websites, which trended toward greater advisability than the remaining 76 websites ($P = .060$), were more likely than the remaining websites to be medical/educational sources ($P = .002$).

Conclusion: Website source type was significantly predictive of medical advisability. Medical/educational websites were the most advisable, while commercial and athletic organization websites were especially poor in their advisability. The overall advisability rate was only 25.6%. When making recommendations to patients, sports medicine providers should highlight the prevalence of discordant online softball pitching guidelines and take the opportunity to share medically advisable resources.

Keywords: softball; youth sports; Internet; prevention; guidelines

The Internet is an accessible resource for athletes, parents, and coaches regarding safety in youth sports. Online information has the potential to considerably impact the expectations and guidelines for youth athletic training. The risk inherent in this readily available information, however, is that it is often backed by opinion rather than evidence-based medicine.

Approximately 1.3 million players participate annually in USA Softball youth leagues in addition to over 340,000 high school student-athletes who play fast-pitch softball each year, situating fast-pitch softball as the fifth most populous sport among high school girls.^{12,28} Many youth athletes also play in travel softball leagues hosted by organizations such as Little League Softball, United States Specialty Sports Association, Amateur Athletic Union, and Triple Crown Sports, although the exact participation rates in these leagues are not well documented. Pre-COVID-19 pandemic data from the Aspen Institute show a 20.4%

The Orthopaedic Journal of Sports Medicine, 11(7), 23259671231182743
DOI: 10.1177/23259671231182743
© The Author(s) 2023

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

increase in softball participation in kids aged 6 to 12 years from 2018 to 2019, the largest increase across the 18 sports analyzed.²³ Because of its popularity, softball accounts for thousands of youth sports injuries each year. A recent nationwide epidemiological study of cases presenting to emergency departments estimated that 51,112 injuries—2% of which were related to overhead throwing or underhand pitching—occur annually in pediatric softball players, a rate that had grown from 45,000 per year from similarly sourced data spanning the prior 15 years.^{7,9} This incidence is less, although comparable, to that of baseball in which there are approximately 86,146 injuries per year, with 3% secondary to throwing in the field or pitching (both overhead in baseball).⁹ However, it should be noted that cases presenting to the emergency department are frequently contact related,⁹ which represents a different mechanism of injury than the primarily overuse arm injuries most relevant to the current study. Using the National High School Sports Injury Surveillance System, Oliver et al¹⁷ reported that approximately 76% of shoulder injuries and 68% of elbow injuries in softball players were related to a noncontact injury or overuse, perhaps caused by repetitive overhead throwing or underhand pitching. More specifically, Wasserman et al²⁹ calculated the pitching injury rate among high school softball players to be 0.15 per 1000 athlete-exposures.

The reported softball pitching volume is high, secondary to fewer active pitchers per team in comparison to baseball rosters. A softball pitcher may pitch as many as six 7-inning games during a tournament, totaling 1200 to 2000 pitches over just a 3-day period.³¹ Despite what appears to be a concerning propensity for overuse injuries, it was not until recently that research began to thoroughly examine the biomechanics of a softball pitching injury to challenge the once-conventional understanding that softball players are subject to a lower risk of overuse injuries than their baseball counterparts.^{10,14,16,24} It should be noted that an important distinction exists between the overhead baseball pitch—the mechanics of which are mimicked by overhead throwing demonstrated by softball position players and pitchers during defensive live-ball situations—and the underhand windmill softball pitch. Traditionally, it was thought that the windmill softball pitch exerts less stress on the shoulder and elbow joints compared to the overhead baseball pitch¹³; however, recent biomechanical analyses have demonstrated that although the mechanism is different, there exist equivocal distraction forces at the shoulder for both pitching techniques.¹⁰ For example, a study from Werner et al³¹ reported shoulder distraction stress to occur at an average of 94% of a fast-pitch softball pitcher's body

weight, similar to published information on joint loads in baseball pitchers. These sizable distraction forces are generated by the lower extremity and trunk during the windup and stride phases of the windmill pitch, which are transferred through the shoulder and arm during delivery and follow-through.³¹ The combination of high-volume pitching, underestimated force loads, and a false perception of relative safety have positioned softball pitchers at high risk for overuse injuries.

Research and subsequent guidelines for softball injury prevention, including pitch counts, have similarly lagged behind those of baseball. In association with the American Orthopaedic Society for Sports Medicine (AOSSM), the National Council of Youth Sports (NCYS) published preventative guidelines as part of the STOP (Sports Trauma and Overuse Prevention) Sports Injury campaign. These guidelines include pitch count limits and other preventative measures.²⁷ Unlike the Pitch Smart guidelines for youth baseball, outlined and endorsed by organizations from Major League Baseball and USA Baseball to Little League Baseball, the softball guidelines have yet to be formally adopted by USA Softball.^{10,19,21}

The purpose of this study was to assess the source and medical advisability of online pitching recommendations for youth softball players to highlight the risk of misinformation. It was hypothesized that many popular websites would contain content discordant with current medical guidelines regarding underhand softball pitching recommendations.

METHODS

A Google search was performed (new Google Chrome Incognito window [United States region]) on September 14, 2022, using the phrase “youth softball pitching recommendations.” We aimed to analyze 100 websites for this search term by assessing website adherence to medical guidelines regarding arm injury prevention in youth softball pitchers. It should be noted that in this article, uses of the term “pitching” refer to the underhand windmill motion (performed by fast-pitch softball pitchers), whereas uses of “throwing” refer to overhead mechanics such as that utilized by baseball position players, baseball pitchers, softball position players, and softball pitchers during live-ball defensive situations. Website exclusion criteria included (1) product pages or websites purely devoted to the advertisement of a training product (such as a pitching machine) and (2) websites presenting baseball-specific information without reference to softball, even if advisable for baseball

‡Address correspondence to James H. Dove, MD, Rhode Island Hospital, 2 Dudley Street, Providence, RI 02905, USA (email: houstond11@gmail.com).

*The Warren Alpert Medical School, Brown University, Providence, Rhode Island, USA.

†Department of Orthopaedics, The Warren Alpert Medical School, Brown University, Providence, Rhode Island, USA.

Final revision submitted February 22, 2023; accepted April 5, 2023.

One or more of the authors has declared the following potential conflict of interest or source of funding: B.D.O. has received consulting fees from DePuy/Medical Device Business Services, ConMed Linvatec, the Musculoskeletal Transplant Foundation, and Vericel; has received royalties from ConMed Linvatec; has received honoraria from Vericel; has stock options in Vivorte; and is a paid associate editor for *The American Journal of Sports Medicine*. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval was not sought for the present study.

TABLE 1
AOSSM and NCYS Guidelines to Prevent Pitching Injuries in Youth Softball Players^a

No.	Guideline
1	Warm up properly by stretching, running, and gradual pitching
2	Rotate playing other positions besides pitcher
3	Concentrate on age-appropriate pitching and skill development
4	Emphasize control, accuracy, and good mechanics
5	Players aged <13 years: no more than 2 days of consecutive pitching; players aged ≥13 years: no more than 3 days of consecutive pitching. Adhere to following pitch count guidelines: <ul style="list-style-type: none"> • Players aged 8-9 years: 50 pitches/game; 80 pitches/day (days 1 and 2) and then 0 pitches/day (day 3) • Players aged 10-12 years: 65 pitches/game; 95 pitches/day (days 1 and 2) and then 0 pitches/day (day 3) • Players aged 13-14 years: 80 pitches/game; 115 pitches/day (days 1 and 2) and then 80 pitches/day (day 3) • Players aged ≥15 years: 100 pitches/game; 140 pitches/day (days 1 and 2) and then 100 pitches/day (day 3)
6	Avoid pitching on multiple teams with overlapping seasons
7	Focus on flexibility rather than strengthening during season
8	Communicate regularly about how your arm is feeling, and if there is pain or fatigue, speak with a sports medicine professional or athletic trainer if there are any concerns about injuries or prevention strategies
9	Do not pitch with pain
10	See a doctor if pain persists for a week
11	Return to play only when clearance is granted by a health care professional
12	Do not play year-round
13	Radar guns should only be used during competition for best pitch of speed versus changeup (aged ≥15 years)

^aGuidelines were adapted for clarity from NCYS.²⁶ AOSSM, American Orthopaedic Society for Sports Medicine; NCYS, National Council of Youth Sports.

players. To account for the possibility that websites would need to be excluded, we initially recorded the first 120 websites populated on the Google Search engine results page (SERP). The extra websites (positions 101-120) were used as needed to replace those that were excluded from the analysis. In total, 7 websites were replaced with later-occurring websites (positions 101-120) because of the first exclusion criterion.

Websites consistent with the second exclusion criterion—baseball-specific information without reference to softball—were similarly excluded from statistical analyses but were not replaced by the extra websites. There were 14 such websites excluded; thus, a total of 86 websites were analyzed. These websites were not replaced because it became clear that later search results (in the approximate range of positions 110-120) were increasingly irrelevant and more likely to be a repeat of a previous website.

Half of all websites were analyzed by a medical student and the other half by an orthopaedic surgery resident. All website classifications were ultimately reviewed by the lead author (D.F.P.) to ensure consistent classification.

Similar to the classification system in another article from our research group, which examined the advisability of online pitching recommendations for youth baseball players,¹⁸ each search result was assessed only by its landing page, which is the single webpage that appeared after clicking the link from the Google SERP. The first categorization was the quality of the website's information, considered with respect to the STOP Sports Injuries' softball-specific injury prevention guidelines published by the AOSSM and NCYS (Table 1). These guidelines primarily address overuse and are based on a growing body of epidemiological and biomechanical research in softball. The STOP Sports Injuries initiative as a whole was developed by the AOSSM with

support from the American Academy of Orthopaedic Surgeons, the Pediatric Orthopaedic Society of North America, the American Medical Society for Sports Medicine, the American Academy of Pediatrics, Safe Kids USA, the National Athletic Trainers' Association, and the Sports Physical Therapy Section.²⁷

Each website was labeled with 1 of 3 descriptors based on the quality of information:

- *Advisable*: websites that endorsed at least 1 STOP Sports Injuries guideline (eg, avoid using radar guns for players younger than 15 years during competition and all players during practice) and did not support engaging in any risk factors,
- *Neutral*: websites with an absence of discordant and advisable information, or
- *Discordant*: websites that supported behavior aligning with ≥1 risk factors (eg, use of radar guns during practice to increase pitching velocity).

Websites that endorsed pitch counts but with values higher than those proposed by STOP Sports Injuries were classified as neutral because pitch counts in general are beneficial and likely to prevent overuse injuries, but higher pitch counts are not necessarily advisable.

The websites were secondarily categorized based on website source type, which considered the overall website owner, not just information presented on the landing page:

- *Commercial*: websites produced by an individual person or group, including advertisements, opinions, or entertainment (eg, blog);
- *Medical/educational*: websites produced by a medical or educational (ie, .edu websites) institution to provide

TABLE 2
Results by Website Source Type and Informational Quality^a

Website Source Type	Informational Quality			Total
	Advisable	Neutral	Discordant	
Medical/educational	12 (50.0)	9 (37.5)	3 (12.5)	24 (27.9)
Athletic organization	4 (14.3)	13 (46.4)	11 (39.3)	28 (32.6)
Commercial	6 (17.6)	15 (44.1)	13 (38.2)	34 (39.5)
Total	22 (25.6)	37 (43.0)	27 (31.4)	86 (100.0)

^aData are presented as n (%).

medical advice and/or education for patients (eg, orthopaedic medical practice or physical therapy group); or

- *Athletic organization*: websites produced by an athletic league with the intent to educate or provide necessary league information to relevant and interested parties (eg, Little League Softball).

Statistical Analysis

All statistical analyses were performed using SPSS Statistics (Version 28.0.0.0; IBM). For each type of website source (commercial, medical/educational, and athletic organization), comparisons of column proportions among categories of content quality (discordant, neutral, and advisable) were made via chi-square tests of independence and *Z* tests of independent proportions (Bonferroni corrected). Within the source type and quality variables, chi-square goodness-of-fit tests were utilized to assess whether differences existed between frequencies of variable levels. Tests with a *P* value < .05 were considered statistically significant.

RESULTS

Because of the exclusion of 14 baseball-only websites, 86 websites were analyzed (Table 2). Website source type was composed primarily of commercial websites (34/86 [39.5%]), followed by athletic organization (28/86 [32.6%]) and medical/educational (24/86 [27.9%]) websites. There was no difference between the frequencies of medical/educational and athletic organization (*P* = .579), medical/educational and commercial (*P* = .189), and athletic organization and commercial (*P* = .446) websites. Regarding informational quality, neutral websites were the most frequent, accounting for 43.0% (37/86) of all websites. The remaining 57.0% of websites were composed of 27 (31.4%) discordant websites and only 22 (25.6%) advisable websites. While neutral websites trended toward greater frequency than advisable websites (*P* = .051), there was no difference in the frequency between advisable and discordant websites (*P* = .475) or between neutral and discordant websites (*P* = .211).

Notably, 28 of 34 (82.4%) commercial websites and 24 of 28 (85.7%) athletic organization websites were classified as

TABLE 3
Website Source Type and Informational Quality for First 10 Search Results and Remaining 76 Search Results^a

	First 10 Search Results	Remaining 76 Search Results
Website source type		
Medical/educational	7 (29.2)	17 (70.8)
Athletic organization	2 (7.1)	26 (92.9)
Commercial	1 (2.9)	33 (97.1)
Informational quality		
Advisable	5 (22.7)	17 (77.3)
Neutral	4 (10.8)	33 (89.2)
Discordant	1 (3.7)	26 (96.3)

^aData are presented as n (%).

neutral or discordant. Among all source types, medical/educational websites had the highest proportion classified as advisable (12/24 [50.0%]) and the lowest proportion classified as discordant (3/24 [12.5%]). Only 14.3% (4/28) of athletic organization websites and 17.6% (6/34) of commercial websites were advisable.

There was a significant association between website source type and informational quality (*P* = .018). Specifically, medical/educational websites were more likely to be advisable than discordant (*P* = .003) and trended toward being advisable compared to neutral (*P* = .057). Similarly, among all advisable websites, the source type was more likely to be medical/educational websites than athletic organization (*P* = .016) or commercial (*P* = .026) websites. Although not significant, discordant websites trended away from medical/educational source types and comparatively toward athletic organization (*P* = .090) and commercial (*P* = .092) source types.

The first 10 search results were more likely to be medical/educational websites (n = 7) than commercial websites (n = 1) (*P* = .013). The other 20.0% of the first 10 websites were athletic organization sources. In addition, 5 of the first 10 websites were neutral or discordant in quality, while the remaining 5 were advisable (Table 3). Compared to the remaining 76 search results, the first 10 were more likely to be medical/educational websites (*P* = .002). The remaining 76 were more likely than the first 10 to be commercial websites (*P* = .042). Overall, while there was a significant association between position in the search results (first 10 vs remaining 76) and website source type (*P* = .006), there was no association between position and informational quality (*P* = .116). However, the first 10 websites trended (not significant) toward greater advisability than the remaining 76 websites (*P* = .060).

Finally, the direct source for the STOP Sports Injuries' softball-specific guidelines did not appear within the first 100 websites on the SERP. However, there were 4 total recorded references to the guidelines, 2 (50.0%) of which were nested within the first 10 websites. Notably, only one website under the USA Softball domain appeared—in position 66—but did not reference the STOP Sports Injuries guidance.

DISCUSSION

Our analysis found that there existed a significant association between website source type and informational quality for pitching recommendations in youth softball players ($P = .018$). Advisable websites were more likely to be medical/educational sources than athletic organization ($P = .016$) or commercial ($P = .026$) sources. Of the top 86 relevant websites, only 25.6% offered advisable content. This suggests that players, parents, and coaches should be vigilant when consuming online information regarding pitching recommendations for youth softball players.

Advisable websites were more likely to be medical/educational sources than athletic organization or commercial sources. This finding supports the notion that medical websites play a fundamental role in the accurate online education of patients and suggests that providers should direct patients to vetted information such as what may be found on medical websites. On the other hand, 38.2% of commercial websites in our analysis were discordant in nature. This finding is similar to that reported in our prior study examining the advisability of online pitching recommendations for youth baseball in which 35.7% of commercial websites were discordant.¹⁸ From these data, it appears that commercial websites do not offer consistently accurate information for pitching recommendations in youth baseball and softball. Further, our findings agree with previous literature in which academic/physician-authored websites were found to be of higher quality than commercial websites, and congruently, websites with high-quality information were significantly associated with sources affiliated with a professional society.^{22,30} Ultimately, by recommending and directly guiding patients to evidence-based and orthopaedic society-supported resources, physicians and other sports providers can make a difference in their patients' knowledge of arm injury prevention.

Many recent articles have examined the readability of online resources, finding that most are written at a reading level beyond that of the target audience.^{1,2,11} However, not as many have directly analyzed the accuracy of web-based materials by website source type. In a few studies that did, the advisability rate ranged from 49.4%, as reported by Peterson et al²⁰ in their analysis of 87 webpages for the quality of musculoskeletal information on the Internet, to between 76% and 99%, as in Beer et al's⁶ investigation of information regarding facial filler procedures. Our prior analysis of 99 websites regarding pitching recommendations in baseball yielded an advisability rate of 76.8%.¹⁸ In our analysis for online softball recommendations, we found only 25.6% of websites to be advisable in nature, suggesting that the quality of baseball pitching information on the Internet is greater than that of softball.

Overall, the lack of advisability in softball information is especially concerning, given the corollary in which nearly 75% of the websites from our Internet query were neutral or discordant. This may mislead patients who are searching online for softball pitching recommendations without guidance from their physician. It is therefore important for physicians to provide accurate, comprehensive, actionable, and understandable (with age-appropriate reading levels)

materials regarding medical conditions and the prevention of such to their patients. This may take the form of offering physical materials such as educational pamphlets. Providers could also focus on improving patients' health literacy by educating them on how to identify trustworthy sports medicine sources on the Internet and discern for themselves if a website contains accurate information. Referring patients directly to the STOP Sports Injuries website would be foundational in the latter approach.

Google was selected as our search engine of choice because it accounted for an estimated 87.7% of search engine usage over the past year in the United States.²⁵ After entering a search query, however, most users examine the SERP from the top down and overwhelmingly click only on links to websites at the top of the SERP.⁵ The term "click-through rate" (CTR) is defined as the number of clicks that a website link receives divided by the number of times that it is shown (impressions).⁸ CTR estimates by SERP position vary, but it is approximately 40% for position 1, followed by a precipitous drop in which the CTR is only about 5% for position 5 and 2% for position 10.⁴ For this reason, we divided our analyzed websites ($n = 86$) into the first 10 (positions 1-10) and remaining 76 (positions 11-86) websites. Our finding that 50.0% of the first 10 websites were medically advisable, while generally concerning, is contextually promising because this is nearly twice the advisability rate reported among all 86 websites. Moreover, 2 of the 4 total recorded references to the STOP Sports Injuries guidelines were nested within the first 10 websites, which altogether trended toward greater advisability than the remaining 76 websites ($P = .060$). Taken together, these findings suggest that the first 10 results likely feature the best and most medically accurate information for softball pitching recommendations. However, with an advisability rate that still fails to exceed 50%, patients must be vigilant in interpreting online information, regardless of position on the SERP.

Despite specifically including the term "softball" in our search query, 14 baseball-only websites were populated in the SERP. In contrast, our research group previously reported that 100% of websites featured baseball content after a Google search for "youth pitching recommendations," which notably does not specify baseball.¹⁸ This juxtaposition supports the notion that there exists greater research and media emphasis on pitching in youth baseball than in youth softball. This theory, if true, may be explained by the abundance of information from Major League Baseball's Pitch Smart and well-defined recommendations surrounding pitching in youth baseball. Pitch Smart is a thoroughly researched and strongly advertised initiative within the baseball community, leading to a breadth of related content on the Internet.²¹ Unlike USA Baseball, which clearly endorses Pitch Smart, USA Softball is notably absent in referencing the NCYS/AOSSM's softball-specific pitching guidelines.¹⁵ The result is poorly advertised pitching recommendations for softball players and a propensity for softball-specific Google searches to yield considerable baseball-specific content. The pervasiveness of online baseball content is likely explained in part by greater participation in youth baseball than in youth softball.³ However,

with a reported population of over 1.3 million annual youth players within USA Softball leagues, there are convincing numbers to advocate for further softball-specific injury research.²⁸

Limitations

We recognize that this study has limitations. A shared approach to website classification may have affected interrater reliability. These effects were mitigated by prospectively creating well-defined and straightforward descriptions of website source type and content quality classifications. Both website source type and informational quality were categorized into only 3 distinct levels, minimizing the degrees of freedom for potential misclassification. Further, all discrepancies were cross-checked by both classifying parties, and every classification was ultimately reviewed by the lead author to ensure consistency. Another limitation is that we did not use a validated website reliability score such as the *JAMA (Journal of the American Medical Association)* benchmark criteria or DISCERN score. However, our decision to forego the utilization of these scores was intentional, as we aimed to evaluate website concordance specifically and exclusively with regard to evidence-based, professional society-supported softball injury prevention guidelines rather than overall website quality. Finally, our study is limited in that relevant websites may have been missed because our search strategy utilized only a single Google search and did not explore less specific search terms such as “softball pitching.”

CONCLUSION

The results of our Google search for youth softball pitching recommendations indicated that website source type was significantly predictive of medical advisability. Medical/educational websites were relatively advisable in quality, while commercial and athletic organization websites were especially poor in their advisability. A mere 25.6% of the websites analyzed provided exclusively advisable recommendations. When making recommendations to players, parents, and coaches, sports medicine providers should highlight the prevalence of discordant softball pitching guidelines on the Internet and take the opportunity to share well-established, medically advisable resources.

REFERENCES

1. Abdullah Y, Alokozai A, Mathew AJ, Stamm MA, Mulcahey MK. Patient education materials found via Google search for shoulder arthroscopy are written at too-high of a reading level. *Arthrosc Sports Med Rehabil*. 2022;4(4):e1575-e1579.
2. Abdullah Y, Alokozai A, O'Connell S, Mulcahey MK. Online patient education materials for common sports injuries are written at too-high of a reading level: a systematic review. *Arthrosc Sports Med Rehabil*. 2022;4(3):e861-e875.
3. About USA Baseball. USA Baseball. Available at: <https://www.usabaseball.com/about/about-usa-baseball#:~:text=Nearly%20every%20major%20national%20amateur,and%20playgrounds%20across%20the%20country>. Accessed January 28, 2023.
4. Bailyn E. Google click-through rates (CTRs) by ranking position in 2022. Available at: https://www.linkedin.com/pulse/google-click-through-rates-ctrs-ranking-position-2022-evan-bailyn/?trk=pulse-article_more-articles_related-content-card. Accessed July 7, 2023.
5. Barry C, Lardner M. A study of first click behaviour and user interaction on the Google SERP. In: Pokorny J, Repa V, Richta K, et al. *Information Systems Development. Business Systems and Services: Modeling and Development*. Springer; 2011:89-99.
6. Beer AJ, Eggerstedt M, Urban MJ, Smith RM, Revenaugh PC. Quality-based evaluation of patient-facing online education materials regarding facial filler procedures. *Facial Plast Surg*. 2022;38(3):300-306.
7. Birchak JC, Rochette LM, Smith GA. Softball injuries treated in US EDs, 1994 to 2010. *Am J Emerg Med*. 2013;31(6):900-905.
8. Clickthrough rate (CTR): definition. Google. Available at: <https://support.google.com/google-ads/answer/2615875?hl=en>. Accessed January 28, 2023.
9. Farooqi AS, Lee A, Abreu E, Talwar D, Maguire KJ. Epidemiology of pediatric baseball and softball player injuries. *Orthop J Sports Med*. 2021;9(12):23259671211052585.
10. Fry KE, Wittman K, Gerke D, Parr A. Clinical and biomechanical evaluation of the softball pitcher: a review of current concepts and clinical commentary. *Clin J Sport Med*. 2019;29(5):406-412.
11. Gao B, Shamrock AG, Gulbrandsen TR, et al. Can patients read, understand, and act on online resources for anterior cruciate ligament surgery? *Orthop J Sports Med*. 2022;10(7):23259671221089977.
12. High school athletics participation survey: based on competition at the high school level in the 2021-22 school year. National Federation of State High School Associations. Available at: https://www.nfhs.org/media/5989280/2021-22_participation_survey.pdf. Accessed December 11, 2022.
13. Loosli AR, Requa RK, Garrick JG, Hanley E. Injuries to pitchers in women's collegiate fast-pitch softball. *Am J Sports Med*. 1992;20(1):35-37.
14. Minetos PD, Trojan JD, Brown SM, Mulcahey MK. Softball pitching mechanics and shoulder injuries: a narrative review. *Sports Biomech*. 2023;22(6):715-727.
15. MLB, USA Baseball supplement Pitch Smart guidelines for 2021 season. USA Baseball. Available at: <https://www.usabaseball.com/news/topic/general/mlb-usa-baseball-supplement-pitch-smart-guidelines-for-2021-season>. Accessed February 8, 2023.
16. Oliver GD, Downs JL, Friesen KB, et al. Biceps tendon changes and pitching mechanics in youth softball pitchers. *Int J Sports Med*. 2021;42(3):277-282.
17. Oliver GD, Saper MG, Drogosz M, et al. Epidemiology of shoulder and elbow injuries among US high school softball players, 2005-2006 through 2016-2017. *Orthop J Sports Med*. 2019;7(9):2325967119867428.
18. Painter DF, Dove JH, Monteiro K, Kriz PK, Owens BD. Medical advisability of youth pitching recommendations on the Internet. *Orthop J Sports Med*. 2021;9(9):23259671211036692.
19. Paul J, Brown SM, Mulcahey MK. Injury prevention programs for throwing injuries in softball players: a systematic review. *Sports Health*. 2021;13(4):390-395.
20. Peterson S, Rainey N, Weible K. Who writes this stuff? Musculoskeletal information quality and authorship of popular health websites: a systematic review. *Musculoskelet Sci Pract*. 2022;60:102563.
21. Pitch Smart guidelines. Major League Baseball. Available at: <https://www.mlb.com/pitch-smart>. Accessed December 11, 2022.
22. Plusch K, Carfagno J, Givner D, et al. An evaluation of the source and content of Dupuytren's disease information available on the Internet. *Cureus*. 2021;13(11):e19356.
23. Pre-pandemic trends ages 6-12. Aspen Institute. Available at: <https://www.aspenprojectplay.org/state-of-play-2020/ages-6-12>. Accessed January 28, 2023.
24. Scarborough DM, McCunney RC, Berkson EM, Oh LS. The relationship of elbow alignment and kinematics on shoulder torque during the softball pitch: a biomechanical analysis of female softball pitchers. *J Shoulder Elbow Surg*. 2019;28(2):357-364.

25. Search engine market share in United States of America: December 2022. StatCounter. Available at: <https://gs.statcounter.com/search-engine-market-share/all/united-states-of-america>. Accessed January 28, 2023.
26. Softball injury prevention. National Council of Youth Sports. Available at: https://www.ncys.org/wp-content/uploads/2022/02/2022_ST_Softball-Injuries-2.pdf. Accessed December 11, 2022.
27. STOP Sports Injuries. National Council of Youth Sports. Available at: <https://ncys.org/safety/stop-sports-injuries/>. Accessed December 11, 2022.
28. USA Softball youth program. USA Softball. Available at: <https://www.teamusa.org/usa-softball/play-asa/youth#:~:text=Over%2080%2C000%20teams%2C%201.3%20million,softball%20on%20an%20annual%20basis>. Accessed December 11, 2022.
29. Wasserman EB, Register-Mihalik JK, Sauers EL, et al. The first decade of web-based sports injury surveillance: descriptive epidemiology of injuries in US high school girls' softball (2005–2006 through 2013–2014) and National Collegiate Athletic Association women's softball (2004–2005 through 2013–2014). *J Athl Train*. 2019;54(2):212-225.
30. Weil AG, Bojanowski MW, Jamart J, Gustin T, Leveque M. Evaluation of the quality of information on the Internet available to patients undergoing cervical spine surgery. *World Neurosurg*. 2014;82(1-2):e31-e39.
31. Werner SL, Guido JA, McNeice RP, et al. Biomechanics of youth windmill softball pitching. *Am J Sports Med*. 2005;33(4):552-560.