

Original Research

Advancements for the Future: A National Survey of Fastpitch Softball Coaches' Perspectives on Injury Prevention Programming

Jaime Nurrenbern¹, Courtney Klueppel¹, Jeff Tilly², Kyle Matsel^{1,3} ^a

¹ Physical Therapy, University of Evansville, ² Athletic Training, University of Evansville, ³ ProRehab, PC

Keywords: injury prevention programs, risk factors, softball coaches, survey

<https://doi.org/10.26603/001c.83262>

International Journal of Sports Physical Therapy

Vol. 18, Issue 4, 2023

Background

Approximately 50 percent of softball injuries are the result of overuse or chronic conditions. However, research exploring preventative measures for softball players is limited and usage of injury prevention strategies among softball coaches is unknown.

Hypothesis/Purpose

This survey aimed to investigate if softball coaches are implementing injury prevention programs to reduce injury and improve the performance of their players. The secondary purpose was to identify barriers to the implementation of injury prevention programs. Finally, this survey explored the coaches' knowledge of injury risk factors and their views on design and usage of preventative programs.

Study Design

Descriptive cross-sectional survey

Methods

A 35-item survey was sent to approximately 14,000 high school and collegiate fastpitch softball coaches throughout the United States. Data were collected over a three-month period with an overall response rate of 1.2%.

Results

Among responding coaches, 45.9% (n=79/172) reported implementing injury prevention programs. Coaches who implement injury prevention strategies most frequently utilize team-based programs (68.8%, n=52/93) compared to group-based (19.0%, n=15/93) or individualized programs (15.2%, n=12/93). Coaches who do not use preventative programming reported that being unsure of what program to perform (53.8%, n=50/93) and not having enough staff (20.4%, n=19/93) were the greatest barriers to implementation. Although over 50% of coaches recognized arm fatigue/overuse (27.9%, n=48/172) and decreased core strength (22.7%, n=39/172) were important risk factors, 36% (n=94/172) "disagree" that softball pitchers should adhere to pitch counts and 90% (n=83/92) believe that preventative programming for pitchers and position players should be similar.

^a Corresponding Author:
Kyle Matsel PT, DPT, PhD
University of Evansville
515 Bob Jones Way
Evansville, IN 47708
Phone: (812) 488-5105
Email: km218@evansville.edu

Conclusion

Less than 50 percent of softball coaches implement exercise programs to prevent injury. Limited familiarity with effective program design, inadequate staffing, and inconsistent risk factor awareness are the major contributors to lacking implementation. Collaboration between rehabilitation professionals and softball coaches regarding preventative programming should be considered.

Level of Evidence

Level 3

INTRODUCTION

Softball is a rapidly growing and evolving sport, drawing the attention of millions across the world.¹ With the amplifying intensity of softball games, there has been an associated increased prevalence of musculoskeletal injury in the sport.² The injury incidence for high school and college fast pitch softball (FPS) players is 1.16 and 3.19 per 1000 athletic exposures (AE), respectively.³ Although several injuries occur from trauma associated with sliding,⁴ being hit by a pitch, or sustaining a concussion,⁵ approximately fifty percent of FPS injuries are from overuse or chronic conditions.⁶ Due to similarities between softball and baseball, such as dominant shoulder retroversion⁷ and comparable shoulder distraction torque during pitching, most research has focused primarily on the injury risk prevention of baseball players. As a result, there is a paucity of research exploring injury rates and preventative measures for FPS players.⁸

Musculoskeletal injuries can affect various body locations and occur frequently in both softball pitchers and position players.^{1,2} Interestingly, position players tend to more commonly experience lower extremity injuries whereas pitchers sustained a more equal distribution of injuries between the upper and lower extremities.² FPS pitchers appear to be more vulnerable to time-loss injuries compared to position players. In a systematic review, Paul et al¹ reported that 37.5% of injuries in FPS pitchers were directly attributed to pitching with 61% of those involving the shoulder. These findings are suggestive that the biomechanics behind pitching,⁹ especially in the shoulder, and pitching volume¹⁰ could expose pitchers to throwing-related injuries. Furthermore, the prevalence of injury increases as the experience of the softball pitcher increases.¹¹ For example, college softball pitchers tend to demonstrate less upper extremity range of motion when compared to high school-level pitchers.¹² This decrease in mobility could be a contributing factor to increased injury rates¹³ and has led coaches to consider implementing dynamic warm-ups and preventative exercise programs.¹⁴

Injury prevention programs generally consist of stretching or strengthening exercises that are designed to maintain adequate mobility and strength throughout the season.¹⁴ Although much attention has been focused on shoulder strengthening, declines in the function of the lower body are common. Specifically, the microtrauma from the stress endured throughout the softball season results in declines in strength, altered shoulder total arc of motion, and decreased hip rotational range of motion.¹⁵ Due to the diverse nature of softball injuries, many researchers have

suggested that injury prevention programs should be individualized to address the unique limitations of the players.^{14,16,17} However, current perspectives from high school baseball coaches reflect a preference toward the utilization of team-based injury prevention to maintain arm health.¹⁸ Unfortunately, established evidence-based injury prevention programming does not currently exist for softball players. Furthermore, it is unknown to what extent fastpitch softball coaches are using novel injury prevention programming and how those programs are structured.

The authors are unaware of another study that has explored FPS coaches' views on injury prevention programs and their willingness to implement an evidence-based program. Therefore, the purpose of this study was to investigate if FPS coaches are implementing injury prevention programs to reduce injury and improve the performance of their players. It was hypothesized that less than 50% of responding FPS coaches are implementing injury prevention programs. The secondary purpose was to identify common barriers to the implementation of injury prevention programs. It was hypothesized that a lack of access to effective injury prevention programming and resources would be identified as the greatest barrier to implementation. Finally, this survey explored the coaches' knowledge of injury risk factors and their views specific to the structural design and usage of injury prevention programs. It was hypothesized that most coaches who are performing injury prevention will be using team or group-based programming and will demonstrate a limited understanding of risk factor management.

MATERIALS AND METHODS

SURVEY DEVELOPMENT

This was a descriptive, cross-sectional study using an electronic survey to evaluate the current usage and effectiveness of injury prevention programs among softball coaches in the United States. The electronic survey (Appendix 1) was developed in Qualtrics (electronic data capture tools hosted at the Rocky Mountain University of Health Professions) based on the current literature involving injury prevention exercise programs in softball players. The survey was created by two physical therapy students (JN and CK) who modified it from a previous survey conducted by Matsel et al¹⁸ which explored high school baseball coaches' perspectives on injury prevention implementation. The students collaborated with an associate professor (KAM) with

multiple years of clinical and research experience working with softball athletes during survey development.

SURVEY SAMPLING

Approximately 14,000 FPS coaches were contacted through email to participate in the online survey. Distribution of the survey was administered by the Clell Wade Coaches Online Directory. This organization has databases containing the email addresses of several thousands of high school and collegiate FPS coaches. The Clell Wade organization contacted the participants directly through their email database and provided them with the electronic link to the survey. In addition to using Clell Wade Coaches Online Directory, the survey was posted on multiple social media platforms to reach FPS coaches who are not represented in this database.

The investigators of this study did not have access to participants' emails or any other personally identifiable information. Participation in the survey was voluntary and all responses to the survey questions were anonymous. Prior to beginning the survey, participants read the consent form and checked the "I agree" option if they wished to consent to the study. Participants were included in the study if they were willing and able to complete the online survey. Participants were excluded if they did not complete all the required survey questions, could not read English, or selected the "I do not agree" to consent option prior to filling out the survey. Responses to the online survey were prospectively collected for three consecutive months from June to August 2022. Approval from the institutional review board at the University of Evansville was obtained prior to data collection for this descriptive survey study.

STATISTICAL METHODS

Descriptive statistics for nominal and ordinal data were summarized through frequencies and percentages and analyzed for differences with a chi-square test. Cross tabulations and chi-square tests of independence were used to consider associations between the use of injury prevention programs and coaching experience, age, and education level. An alpha level of $p < 0.05$ was considered statistically significant for all tests. All data analyses were performed with R for Mac OS 4.1.2 statistical software (RStudio for Mac, Version 2022.12.0+353).

RESULTS

Demographic information for the level and age of softball players coached and the responding coaches' years of coaching experience is presented in [Table 1](#). A total of 218 FPS coaches throughout the United States responded to the survey between June 1, 2022 and August 30, 2022. Of these 218 surveys, 46 surveys were excluded due to being incomplete or failing to meet the inclusion criteria. Therefore, the remaining 172 surveys represented an inclusion rate of 79% (172/218) and were used for data analyses.

INJURY PREVENTION PROGRAMMING

Among softball coaches who responded to the survey, 45.9% ($n=79/172$) reported that their players participate in an injury prevention program ([Table 2](#)). Coaches who implement injury prevention strategies most frequently utilize team-based programs (68.8%, $n=52/93$) compared to group-based (19.0%, $n=15/93$) or individualized programs (15.2%, $n=12/93$) which focus on specific demands or limitations unique to each player ($p<0.001$). Interestingly, 85% ($n=146/172$) of responding coaches would be interested in a screening tool to better inform individualized injury prevention initiatives ([Table 2](#)).

Collegiate-level softball coaches are more likely to implement injury prevention programs ($p=0.005$) and more likely to individualize their programs ($p<0.001$) to meet the specific needs of their players compared to high school-level coaches. However, there was no significant difference between softball coaches' usage of injury prevention programming and years of coaching experience ($p=0.22$) ([Table 3](#)). Over 50% (50.6%, $n=40/79$) of coaches implementing injury prevention programs report that preventative exercises should be performed throughout the season and completed at least two to three times per week (64.5%, $n=51/79$). Furthermore, 44% ($n=41/93$) of coaches consider 5-10 minutes of practice time a reasonable amount of time to dedicate to injury prevention exercises ([Table 2](#)).

BARRIERS TO INJURY PREVENTION PROGRAMMING

The coaches' perceptions of the greatest barriers to implementing injury prevention programs are summarized in [Figure 1](#). Responding softball coaches who did not perform injury prevention programs reported that being unsure of what program to perform (53.8%, $n=50/93$) and not having enough staff to assist with program design and execution (20.4%, $n=19/93$) were the greatest barriers to implementation. Only 4.4% of 93 softball coaches reported not implementing preventative exercises due to previous experience with ineffective programs (2.2%, $n=2/93$) or beliefs that injury prevention programs typically do not affect injury occurrence (2.2%, $n=2/93$). Further, if an evidence-based injury prevention program were developed that showed promise at reducing injury incidence in softball players, 73% ($n=68/93$) of the coaches currently not implementing preventative programming would reconsider inclusion of programming.

RISK FACTOR MANAGEMENT AWARENESS

Most responding FPS coaches (64.6%, $n=51/79$) who have their players perform exercise programs reported that the program's main goal is the prevention of injuries ([Figure 2](#)). Among FPS coaches, 83.7% ($n=144/172$) "strongly agree" that injury risk factors should be monitored throughout the entire season. Participating coaches reported that arm fatigue/overuse (27.9%, $n=48/172$) and decreased core strength (22.7%, $n=39/172$) were the most important risk factors affecting player availability during the season. Interestingly, 36% ($n=94/172$) of surveyed coaches "disagree"

Table 1. Demographics of Fastpitch Softball Coaches

	n (%)
What level of team do you coach?	
High school	107 (62)
Travel	38 (22)
10U	6 (15.8)
12U	8 (21.1)
14U	14 (36.8)
16U	7 (18.4)
18U	3 (7.9)
College	27 (15.7)
Division I	5 (18.5)
Division II	3 (11.1)
Division III	6 (22.2)
NAIA	8 (29.6)
NJCAA	5 (18.5)
How many years have you been involved in coaching softball?	
< 1 years	12 (6.98)
1-3 years	28 (16.3)
4-6 years	29 (16.9)
7-10 years	28 (16.3)
>10 years	75 (43.6)

* NAIA = National Association of Intercollegiate Athletes

* NJCAA = National Junior College Athletic Association

or “strongly disagree” that softball pitchers should have a pitch count limitation. Furthermore, 90% (90.2%, n=83/92) of responding coaches reported that injury prevention programming should be similar for pitchers and position players. Overall, FPS coaches reported that the players (50%, n=86/172) and coaches (35.5%, n=61/172) play the largest role in preventing softball injuries ([Figure 3](#)).

DISCUSSION

The overarching aim of this survey was to explore the practice and implementation of injury prevention programs by FPS coaches. The results of the survey support the primary hypothesis that less than 50% of responding FPS coaches are implementing injury prevention programs. Overall, most coaches who implement injury prevention programs utilized team-based or group-based programs. However, college-level coaches implement injury prevention programs and individualize those programs more frequently compared to high school coaches. The coaches agree that injury prevention programs are effective at reducing injuries, but largely fail to implement them due to uncertainty of what programs to perform.

There is limited research specific to structured injury-preventative programming for softball players which makes evidence-based program development decisions difficult for coaches. However, there are consistencies between the results of this current survey of fastpitch softball coaches and previous research on perceived vital programming

components. In a recent systematic review, Paul et al¹ highlighted the most common injury risk factors in softball players were associated with the shoulder complex, core stabilization, and hip strength. In the current survey, coaches highlighted the importance of shoulder and hip strengthening to improve durability throughout the season. However, coaches failed to recognize the importance of core stability as a risk factor by ranking the shoulder (97.83%, n=90/431), knee (77.17%, n=71/431), and hip (70.65%, n=65/431) ahead of the core as the three most important body regions to include in injury prevention programming. Although a direct relationship between core stability and injury incidence has not been established in softball players,¹⁹ core stability is a foundational component of overall athlete performance especially in rotational sports such as softball.²⁰

Although rotational sports such as softball and baseball are commonly referred to as overhead sports which suggests a desire to strengthen the throwing shoulder, the entire kinetic chain including the lower body plays a role in player durability and performance. In the current survey, responding coaches suggest that hip and knee exercises should be included in programming, but lower body (hip, knee, ankle, foot) mobility and strength were not rated as major injury risk factors (9.88%, n=17/172). One possible explanation could be that coaches consider the lower body important for performance enhancement but not as critical for injury prevention. Guy et al.¹⁵ reported that hip range of motion and strength appears to decrease throughout the softball season in both pitchers and position players. Hip

Table 2. Injury Prevention Programming Application and Usage

	n (%)
Do your players perform an injury prevention program?	
Yes	79 (45.9)
No	93 (54.1)
Which of the following best describes your injury prevention program?	
Team-Based – every athlete performs the same routine	52 (68.8)
Group Based – different program based on playing position	15 (19.0)
Individualized – program based on individual limitations	12 (15.2)
Would you be interested in a 3-minute screen to help individualize your prevention program?	
Yes	146 (84.9)
No	26 (15.1)
What is a reasonable amount of time to dedicate to injury prevention during practice?	
≤ 5 minutes	7 (7.61)
6-10 minutes	41 (44.6)
11-15 minutes	33 (35.9)
16-20 minutes	11 (12.0)
How many times a week do your players perform your injury prevention program?	
1x/week	3 (3.8)
2x/week	17 (21.5)
3x/week	34 (43.0)
4x/week	6 (7.6)
5x/week	12 (15.2)
6x/week	5 (6.3)
7x/week	2 (2.5)
What time of year do you have your players perform your injury prevention program?	
Year-round	26 (32.9)
Preseason only	7 (8.9)
During the season only	5 (6.3)
Offseason only	1 (1.3)
Pre-season through end of season	40 (50.6)

Table 3. Relationship Between Player Level or Coaching Experience & Injury Prevention Usage

Is coaching experience related to injury prevention implementation?	Yes	No	p value
1-6 years of experience	38.0%	62.0%	0.22
>7 years of experience	48.4%	51.6%	
Is coaching experience related to use of individualized injury prevention?	Group/Team	Individual	p value
1-6 years of experience	86.7%	13.3%	0.97
>7 years of experience	83.7%	16.3%	
Is the level of softball players related to injury prevention usage?	Yes	No	p value
High School/Travel team level players	41.4%	58.6%	0.005*
College level players	70.4%	29.6%	
Is the level of player related to use of individualized injury prevention?	Group/Team	Individual	p value
High School/Travel team level players	17.2%	82.8%	<0.001*
College level players	93.3%	6.7%	

* indicates a statistically significant association

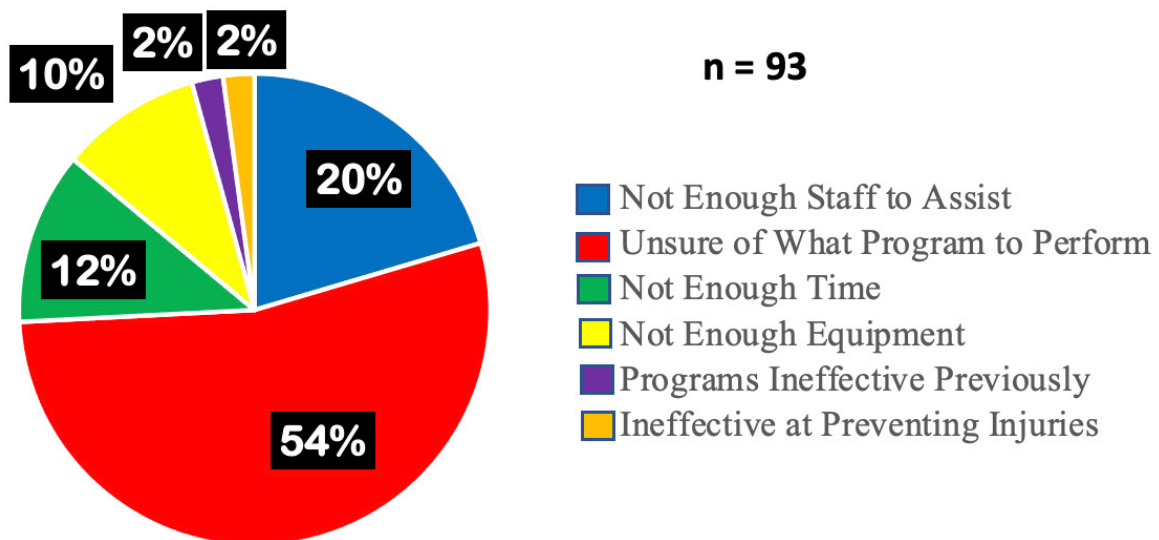


Figure 1. The most significant factor why fastpitch softball coaches don't implement injury prevention programs

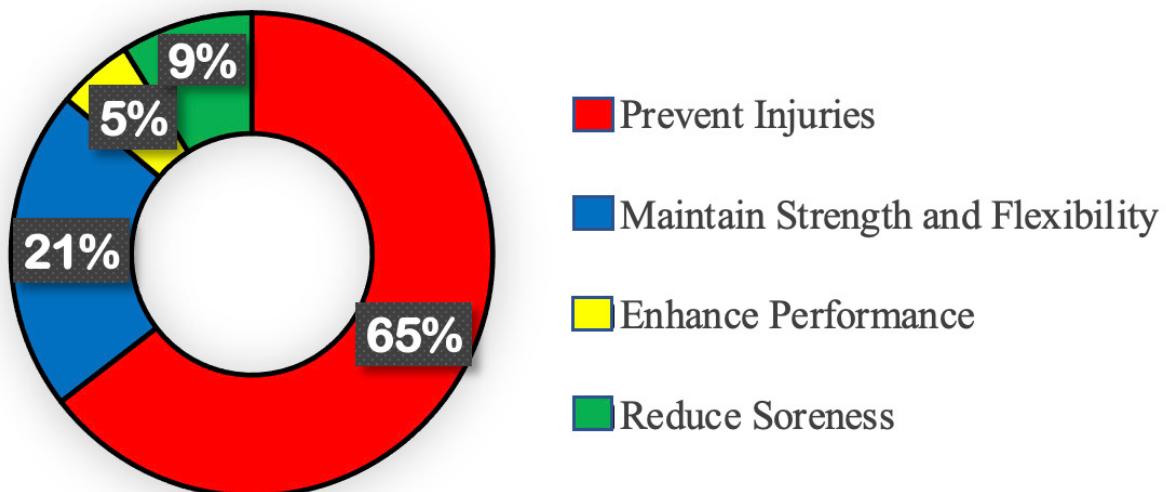


Figure 2. Fastpitch Softball coaches' primary goal of Injury Prevention Programming

mobility declines have also been demonstrated in baseball players throughout the season^{21,22} and have been associated with increased stress on the throwing arm.²³ To date, no studies have specificity associated hip mobility declines with increased risk of arm injury in softball players; however, it seems logical that maintaining hip mobility and strength throughout the season could be advantageous.

Although the entire kinetic chain contributes to throwing performance and durability, much of the mechanical stress from throwing frequently does manifest in the shoulder and elbow of overhead athletes.²⁴ Interestingly, the throwing shoulder of softball pitchers is subjected to similar distraction forces as seen in a baseball pitcher.²⁵ However, softball pitchers have more relaxed pitch counts and recovery guidelines compared to baseball players. Current research has identified a direct relationship between seasonal throwing volume and development of arm pain in

high school softball pitchers.²⁶ In the current survey, less than half of surveyed coaches (45.4%, n=78/172) were in favor of standardized pitch count guidelines in softball, even though multiple studies have discussed the concept of overuse leading to increased incidence of softball injuries.^{10,27,28} Pitch count adherence is an emerging concept for softball coaches largely due to the biomechanical and tissue stresses of the windmill style pitch being understudied.²⁹ This could explain why the majority of participating coaches in this survey did not recognize pitch counts as a strong injury prevention priority.

Among the responding coaches who implement injury prevention, most utilize group or team-based programs instead of individualized programs. This is consistent with available literature which has explored injury prevention programs for softball players.¹ Individualized prevention programs can be more challenging to implement and re-

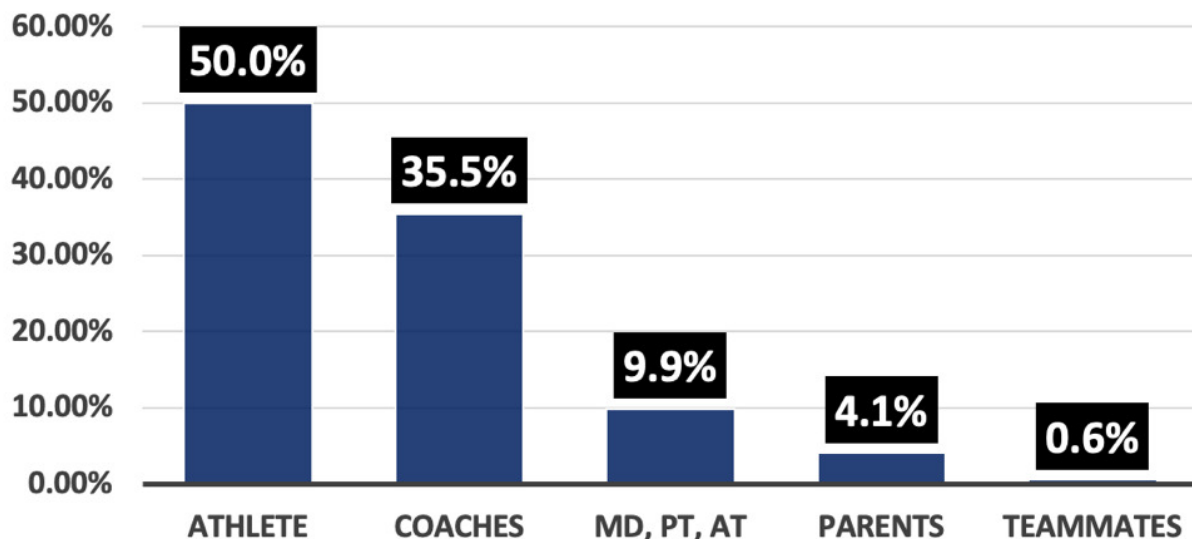


Figure 3. Softball coaches' response to who plays the greatest roles in preventing softball injuries

quires frequent testing to establish the athlete's baseline strength, range of motion, and balance.³⁰ Likewise, 90% (n=83/92) of responding coaches reported that pitchers and position player should perform similar injury prevention programs throughout the season. The softball pitch requires unique muscular demands²⁵ and joint motions³¹ of the upper and lower body which suggests that softball pitchers could benefit from a more individualized injury prevention program which differs from programming for position players. For example, the overhand thrower needs to absorb the vertical force in the stride leg while the wind-mill pitcher needs to post-up on the stride foot to transfer force into the ball.²⁵ As a result, softball coaches may need to assume a more active role in developing specific injury prevention programs based on the unique demands of the player's position and physical function. In the current survey, 50% (n=80/172) of coaches indicated that the players have the biggest role in overall player health and preventing injuries. In comparison to a similar survey by Matsel et al.,¹⁸ 57% of baseball coaches believed they played the largest role in player health, while only 38% of coaches responded that athletes are the most responsible. These two studies highlight the self-advocacy and autonomy of coaches and athletes, demonstrating they can reduce injury rates without dependence on parents, teammates, and other medical providers (physical therapists, athletic trainers, physicians).

As more research surfaces about fastpitch softball and the increasing injury rates, better educational accessibility and applicability for coaches and players is warranted. Those who design injury prevention routines should have access to the knowledge needed to create programs focused on targeting body regions known to contribute to injury. An apparent gap exists between the recommendations established in the medical literature and the practical utilization of injury prevention programs among softball coaches. In the future, better collaboration between rehabilitation pro-

fessionals and softball coaches could result in more effective programming to mitigate the growing injury rates in fastpitch softball. Future research should explore common physical risk factors which develop throughout the softball season as a basis for informing a comprehensive injury prevention exercise program.

LIMITATIONS

The results of this survey should be interpreted conservatively as the authors recognize some significant limitations. First, the sample size of the responding coaches who completed the survey was smaller than anticipated resulting in underpowered results. The authors attempted to reach as many FPS coaches throughout the United States as possible through access to mailing lists from professional organizations and private databases, but many of these mailing lists may have been outdated with discontinued emails or coaches who are no longer actively engaged in coaching. The total number of active FPS coaches is difficult to estimate but the small response rate of 1.2 percent may not be reflective of the perspectives of the entire population of softball coaches. Second, the authors used email to survey a geographically diverse sample of FPS coaches throughout the United States. However, technological restrictions such as limited access to a computer or the internet may have resulted in a selection bias. Finally, there were a limited number of college-level coaches who responded to the survey. The authors sought to survey FPS coaches from both college and high school levels to determine similarities and differences, however, college coaches only represented 15% of the sample thus limiting the conclusions.

CONCLUSION

The results of this survey suggest that less than 50% of responding fastpitch softball coaches implement injury pre-

vention programs to prevent injury. Limited familiarity with effective program design, inadequate staffing, and inconsistent risk factor awareness are the major contributors to lacking implementation. Educational collaboration between rehabilitation professionals and softball coaches regarding preventative programming strategies and injury risk factor management should be considered.

.....

DISCLOSURE STATEMENT

The authors have no financial disclosures to report

ACKNOWLEDGMENTS

The authors would like to thank the University of Evansville Department of Physical Therapy and the Ridgeway Student Research Endowment for funding this project.

Submitted: February 11, 2023 CDT, Accepted: May 24, 2023 CDT



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-NC-4.0). View this license's legal deed at <https://creativecommons.org/licenses/by-nc/4.0> and legal code at <https://creativecommons.org/licenses/by-nc/4.0/legalcode> for more information.

REFERENCES

1. 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. doi:10.1177/1941738120978161
2. Patel N, Bhatia A, Mullen C, Bosman E, Lear A. Professional women's softball injuries: An epidemiological cohort study. *Clin J Sport Med*. 2021;31(1):63-69. doi:10.1097/jsm.0000000000000698
3. 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. doi:10.4085/1062-6050-206-17
4. Stovak M, Parikh A, Harvey AT. Baseball and softball sliding injuries: Incidence and correlates during one high school league varsity season. *Clin J Sport Med*. 2012;22(6):501-504. doi:10.1097/jsm.0b013e3182580d05
5. Riccio CA, Balaji N, Pierrot R, et al. Play ball: A 10-year comparative analysis of craniofacial safety in baseball and softball. *J Craniofac Surg*. 2022;33(6):1690-1692. doi:10.1097/scs.00000000000008487
6. 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):232596711986742. doi:10.1177/2325967119867428
7. Biaggi K, Farmer B, Hobson M, Self C, Grindstaff TL. Shoulder strength and range of motion in healthy collegiate softball players. *J Athl Train*. 2021;56(10):1086-1093. doi:10.4085/301-20
8. Pollack KM, Canham-Chervak M, Gazal-Carvalho C, Jones BH, Baker SP. Interventions to prevent softball related injuries: A review of the literature. *Inj Prev*. 2005;11(5):277-281. doi:10.1136/ip.2004.007195
9. Flyger N, Button C, Rishiraj N. The science of softball: Implications for performance and injury prevention. *Sports Med*. 2006;36(9):797-816. doi:10.2165/00007256-200636090-00006
10. Gooch B, Lambert BS, Goble H, McCulloch PC, Hedt C. Relationship between pitch volume and subjective report of injury in high school female fast-pitch softball pitchers. *Sports Health*. 2021;14(5):702-709. doi:10.1177/19417381211051381
11. Holtz KA, O'Connor RJ. Upper extremity functional status of female youth softball pitchers using the kerlan-jobe orthopaedic clinic questionnaire. *Orthop J Sports Med*. 2018;6(2325967117748599).
12. West AM, Scarborough DM, McInnis KC, Oh LS. Strength and motion in the shoulder, elbow, and hip in softball windmill pitchers. *PM&R*. 2019;11(12):1302-1311. doi:10.1002/pmjr.12135
13. Shanley E, Rauh MJ, Michener LA, Ellenbecker TS, Garrison JC, Thigpen CA. Shoulder range of motion measures as risk factors for shoulder and elbow injuries in high school softball and baseball players. *Am J Sports Med*. 2011;39(9):1997-2006. doi:10.1177/0363546511408876
14. McKeon P, Oliver GD. The windmill softball pitch, part 2: Injury prevention. *Int J Athl Ther Train*. 2011;16(1):27-31. doi:10.1123/ijatt.16.1.27
15. Guy CR, Zeppieri Jr. G, Bruner ML, Davis K, Farmer KW. Shoulder and hip range of motion and strength changes throughout a season in college softball players. *Int J Sports Phys Ther*. 2021;16(6):1492-1503. doi:10.26603/001c.29515
16. Hibberd EE, Oyama S, Myers JB. Increase in humeral retrotorsion accounts for age-related increase in glenohumeral internal rotation deficit in youth and adolescent baseball players. *Am J Sports Med*. 2014;42(4):851-858. doi:10.1177/0363546513519325
17. Hill JL, Humphries B, Weidner T, Newton RU. Female collegiate windmill pitchers: Influences to injury incidence. *J Strength Cond Res*. 2004;18:426-431.
18. Matsel KA, Weiss EE, Butler RJ, et al. A nation-wide survey of high school baseball coaches' perceptions indicates their arm care programs play a role in injury prevention. *Int J Sports Phys Ther*. 2021;16(3):816-826. doi:10.26603/001c.24247
19. Silfies SP, Ebaugh D, Pontillo M, Butowicz CM. Critical review of the impact of core stability on upper extremity athletic injury and performance. *Braz J Phys Ther*. 2015;19(5):360-368. doi:10.1590/bjpt-rbf.2014.0108

20. Zemková E, Zapletalová L. The role of neuromuscular control of postural and core stability in functional movement and athlete performance. *Front Physiol.* 2022;13(796097). [doi:10.3389/fphys.2022.796097](https://doi.org/10.3389/fphys.2022.796097)
21. Chan JM, Zajac J, Erickson BJ, et al. Upper extremity and hip range of motion changes throughout a season in professional baseball players. *Am J Sports Med.* 2020;48(2):481-487. [doi:10.1177/0363546519894567](https://doi.org/10.1177/0363546519894567)
22. Zeppieri GJr, Lentz TA, Moser MW, Farmer KW. Changes in hip range of motion and strength in collegiate baseball pitchers over the course of a competitive season: A pilot study. *Int J Sports Phys Ther.* 2015;10:505-513.
23. Saito M, Kenmoku T, Kameyama K, et al. Relationship between tightness of the hip joint and elbow pain in adolescent baseball players. *Orthop J Sports Med.* 2014;2(5):232596711453242. [doi:10.1177/2325967114532424](https://doi.org/10.1177/2325967114532424)
24. Friesen KB, Saper MG, Oliver GD. Biomechanics related to increased softball pitcher shoulder stress: Implications for injury prevention. *Am J Sports Med.* 2021;50(1):216-223. [doi:10.1177/03635465211055141](https://doi.org/10.1177/03635465211055141)
25. Werner SL, Guido JA, McNeice RP, Richardson JL, Delude NA, Stewart GW. Biomechanics of youth windmill softball pitching. *Am J Sports Med.* 2005;33(4):552-560. [doi:10.1177/0363546504269253](https://doi.org/10.1177/0363546504269253)
26. Yang JS, Stepan JG, Dvoracek L, Wright RW, Brophy RH, Smith MV. Fast-pitch softball pitchers experience a significant increase in pain and fatigue during a single high school season. *HSS J.* 2016;12(2):111-118. [doi:10.1007/s11420-016-9499-3](https://doi.org/10.1007/s11420-016-9499-3)
27. Ritzer EE, Yang J, Kistamgari S, Collins CL, Smith GA. An epidemiologic comparison of acute and overuse injuries in high school sports. *Inj Epidemiol.* 2021;8(1). [doi:10.1186/s40621-021-00344-8](https://doi.org/10.1186/s40621-021-00344-8)
28. Zaremski JL, Zeppieri G Jr, Tripp BL. Sport specialization and overuse injuries in adolescent throwing athletes: A narrative review. *J Athl Train.* 2019;54(10):1030-1039. [doi:10.4085/1062-6050-333-18](https://doi.org/10.4085/1062-6050-333-18)
29. 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. [doi:10.1097/jsm.0000000000000692](https://doi.org/10.1097/jsm.0000000000000692)
30. Matsel KA, Butler RJ, Malone TR, Hoch MC, Westgate PM, Uhl TL. Current concepts in arm care exercise programs and injury risk reduction in adolescent baseball players: A clinical review. *Sports Health.* 2021;13(3):245-250. [doi:10.1177/1941738120976384](https://doi.org/10.1177/1941738120976384)
31. Oliver GD, Wasserberger K, de Swart A, Friesen K, Downs J, Bordelon N. Hip range of motion and strength and energy flow during windmill softball pitching. *J Athl Train.* 2021;56(3):280-285. [doi:10.4085/1062-6050-145-20](https://doi.org/10.4085/1062-6050-145-20)

SUPPLEMENTARY MATERIALS

Appendix 1

Download: <https://ijspt.scholasticahq.com/article/83262-advancements-for-the-future-a-national-survey-of-fastpitch-softball-coaches-perspectives-on-injury-prevention-programming/attachment/170405.pdf>
