

Research Article

Gender Inequality in Reporting Injuries of U.S.A. Collegiate and Professional Athletes: a Narrative Review

Ravali Reddy, M.D.^{1a}, Christina Freiberger, M.D.^{2b}, Mia Rumps, M.S.^{3c}, Bryan Vopat, M.D.^{1d}, Mary K. Mulcahey, M.D.^{3e}

¹ Department of Orthopaedics and Sports Medicine, University of Kansas Medical Center, ² Tulane University, ³ Department of Orthopaedics and Rehabilitation, Stritch School of Medicine, Loyola University Chicago

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- a Ravali Reddy, MD, is an orthopaedic surgery resident at the University of Kansas School of Medicine-Wichita. Her academic interests include orthopaedic trauma and sports medicine, with a focus on clinical outcomes and healthcare equity. Her work thus far aims to support more inclusive research practices and advance orthopaedic education.

[Visit Dr. Ravali Reddy](#)

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- b Dr. Christina Freiberger is originally from the suburbs of Massachusetts. She attended Tulane University for medical school, and she is now an orthopaedic resident at the University of Miami.

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- c Mia Rumps is a second year osteopathic medical student at Midwestern University in Glendale Arizona. She graduated from the University of Pittsburgh with a BS degree in Rehabilitation Science with minors in Chemistry and Italian and a certificate in Pathokinesiology. She continued her education at Loyola University Chicago where she obtained her masters in Medical Physiology. She is excited about her future in medicine!

[Connect with Mia Rumps on LinkedIn](#)

[Conflicts of Interest Statement for Mia Rumps](#)

- d Dr. Bryan Vopat is certified by the American Board of Orthopaedic Surgery. He completed a fellowship at Rhode Island Hospital. He earned his medical degree from the University of Kansas School of Medicine and completed his residency at Rhode Island Hospital. After injuring his ACL in high school he learned how sports medicine doctors help patients get back to their active lives. He was inspired to help patients fulfill their potential when returning from an injury. His clinical focus includes sports medicine and pediatric sports medicine, knee injuries, shoulder injuries, foot and ankle injuries, and arthroscopic surgery. He decided to specialize further in foot and ankle injuries after noticing that many doctors focus on the knee but don't go lower. Athletes are on their feet constantly, and it's important that medical professionals understand how the entire lower body works together. He tries to view the knee, ankle and foot as one unit. He loves helping active people get back to their desired activity levels. That can be anyone from a professional athlete to a weekend warrior to a high school athlete. He works to help them achieve their personal goals and get back to their way of life.

[Visit Dr. Bryan Vopat](#)

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[Visit the Open Payments Data Page for Dr. Bryan Vopat](#)

- e Dr. Mulcahey is a Board Certified orthopaedic surgeon specializing in shoulder and knee surgery and sports medicine. She is a New Hampshire native, who received her Bachelor of Arts in Biochemistry from Dartmouth College and her Doctor of Medicine from the University of Rochester School of Medicine. She completed her orthopaedic residency at Brown University, followed by a fellowship in Orthopaedic Trauma at the same institution. Dr. Mulcahey then went on to do a fellowship in sports medicine at San Diego Arthroscopy and Sports Medicine.

Dr. Mary Mulcahey is Professor and Chief of Sports Medicine in the Department of Orthopaedic Surgery and Rehabilitation at Loyola University Medical Center in Chicago. She is also Director of the Women's Sports Medicine Program at Loyola. Dr. Mulcahey is past President of the Ruth Jackson Orthopaedic Society. Additionally, she recently served on the AANA Board of Directors. She is currently on the AANA Education Committee and the AJSM Electronic Media Editorial Board, and she was selected for the AOSSM Traveling Fellowship to Europe in April 2022. Dr. Mulcahey is a team physician for the Loyola University Chicago Ramblers athletic teams, and she hosts the Lead Change Podcast, which focuses on leadership in medicine.

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Background

The purpose of this study was to provide a detailed summary of current publicly available primary and secondary literature, databases, and websites reporting sports-related injuries among male and female collegiate and professional athletes in the United States of America (U.S.A.) to determine whether gender disparities exist in injury reporting.

Methods

A search was performed in July 2022 using PubMed and Google Scholar to identify studies reporting male and/or female collegiate and professional athlete injuries to identify databases recording this data. Search terms included: gender OR female OR male AND sport OR athlete AND injury AND professional OR collegiate OR college AND soccer OR “baseball OR softball” OR basketball OR hockey. Google Search Engine was used to identify websites/databases. Sports of focus included soccer, baseball/softball, basketball, and hockey for all sports-related injuries in the U.S.A.

Results

The initial search on PubMed and Google Scholar yielded 1,684 studies. Seven websites and four studies met inclusion criteria. Six websites (85.7%) contained injury information focusing on baseball (16.7%), basketball (33.3%), or hockey (50%); one (14.3%) included all sports. No comparable website for female professional athletes identified. The NCAA has an Injury Surveillance Program for collegiate athletes. Four studies detailed methods for information on female collegiate and professional athletes.

Conclusion

While male athletes have injury surveillance programs across various sports, comparable databases for female athletes are lacking. This finding highlights the need for comprehensive injury databases for female athletes, given their increasing participation rates and comparable injury risk to male athletes. Expanding access to injury data for female athletes would aid in tracking risk ratios, creating injury prevention programs, developing treatment protocols, and evaluating outcomes following injury – crucial for healthcare providers and researchers. Adapting existing systems, or creating accessible, filterable databases or websites could be vital for effective, targeted prevention and treatment strategies.

INTRODUCTION

Gender inequality in sports has been a topic of discussion for many years (Archer and Prange 2019; Goldman 2022). Unequal pay, sports media coverage, and opportunities for participation have served as constituents for change among female athletics (Archer and Prange 2019; Goldman 2022; Isidore 2015). Both athletes and coaches have initiated impactful initiatives to pave the way for future female athletes (Archer and Prange 2019; Goldman 2022; Treisman 2022). These domains include advocacy for equal pay, equal media coverage, maternity policies for female athletes, better facilities and resources, and mentorship programs (Archer and Prange 2019; Goldman 2022). Advances in the realm of athletics at a specific level (e.g., youth, high school, collegiate, professional) reveal gaps in our knowledge within another level and contribute to future developments (Costello et al. 2014; Datalys Center 2023; Kaufman et al. 2000; Post et al. 2017). A distinct example of this includes databases that report athlete injuries. Injury databases can serve as a conduit to bring attention to common injuries amongst a specific sport, gender, or age group; to assess current treatment guidelines and possibly direct future treatment regimens. Currently, some form of injury reporting database exists for female and male athletes at the high school

level through the High School Reporting Information On-line (RIO) via the Datalys Center; which was created over the last decade (Datalys Center 2023).

A 2015 study by Costello et al. evaluated the proportion of male versus female participants in studies published in three major sports and exercise medicine journals (Costello et al. 2014). The authors evaluated over 1,382 studies that consisted of 6,076,580 participants and found that only 39% of participants were female. This is particularly relevant to include both male and female participants in research publications, as information on injury history is a strong predictor of future injury (Junge and Dvorak 2004; Kucera et al. 2016). Other factors, such as high sport volume, can serve as a predictor for sport-related injury (Post et al. 2017). This finding was supported by Post et al. who evaluated the risk of lower extremity injury based on participation in high sport volume, which is defined by >60 sport competitions within the past year. Of the 1,544 athletes that were included from 29 high schools, female athletes were more likely to participate in high volume competition (23% versus 11%) and were also more likely to sustain injuries (Post et al. 2017).

While significant research efforts have been made to report anatomical and mechanical factors that may contribute to the gender disparities in sports injuries, no

known published literature discusses possible disparities in injury databases available to healthcare providers and other members of the sports medicine team. The purpose of this study was to provide a detailed summary of the current publicly available primary and secondary literature, databases, and websites reporting sports-related injuries in collegiate and professional athletes in the United States of America (U.S.A.) to determine whether a gender disparity exists.

METHODS

A search was performed in July 2022 using PubMed and Google Scholar to identify studies reporting male and/or female collegiate and professional athlete injuries to identify databases that record this data. Search terms included: gender OR female OR male AND sport OR athlete AND injury AND professional OR collegiate OR college AND soccer OR “baseball OR softball” OR basketball OR hockey. Additionally, the same search terms were used to search the Google Search Engine to identify websites and databases reporting injuries in male and female collegiate and professional athletes. The sports evaluated included soccer, baseball/softball, basketball, and hockey. The search was not limited to specific injuries. All studies, websites, and databases were limited to sports leagues/teams in the U.S.A.

RESULTS

1,684 studies were identified with the initial search on PubMed and Google Scholar. Seven websites and 4 studies met inclusion criteria, which is summarized in Table A1 and A2, respectively. Of the 7 websites, 6 (85.7%) contained injury information that focused on baseball (1/6; 16.7%), basketball (2/6, 33.3%), or hockey (3/6; 50%); while 1 website (14.3%) included all the sports listed. There was no comparable website/database for female professional athletes. At the collegiate level, the NCAA has an Injury Surveillance Program in place for both male and female athletes. Of the four studies included, various methods were used to obtain information about injuries in female collegiate and professional athletes, including manual data collection, questionnaires, daily self-reports by the athletic trainer, physician, or physical therapist, athletic trainer databases, Athletic Healthcare System Daily Injury Report form, and Simtrack Mobility System.

SOCCER

Five studies were identified with information regarding soccer injuries, two (40%) of which were specific to professional leagues and three (60%) on collegiate teams. Among the studies that focused on the professional leagues, one reported on male professional soccer players between 2014 and 2019 (Forsythe et al. 2022). This study collected injury data for Major League Soccer (MLS) players via Health Athlete (Center Corpe), a web-based health management platform that included injury management, personal health records, and advanced reporting to efficiently manage ath-

lete health and health-related data. According to the study by Forsythe et al., the recorded data included: “player position (forward, midfielder, defender, goalkeeper), injury date based on year, injury setting (conditioning, match, team training, or sanctioned training), and body region of injury (spine, head/neck, upper extremity, thorax, abdomen, pelvis, hip, thigh, knee, leg, ankle, or foot), as well as total days, matches, and training sessions missed because of injury.” (Forsythe et al. 2022) Whereas the study by Giza et al., manually collected data on 202 Women’s United Soccer Association (WUSA) players to study injury incidence, location of injuries, and player position (Giza et al. 2005). In this study, injuries were reported to the league insurance company via a form completed by the team athletic trainer and subsequently verified by the team physician. Additionally, for male professional soccer players, injury information including type of injury and date of injury were reported on www.prosportstransactions.com/ (Pro Sports Transactions Archive, n.d.). No comparable website or database was found for female professional soccer players in the U.S.A. Overall, 2 of the 3 (66%) studies focusing on collegiate teams (Division I-III) discussed injuries in college athletes, which were tracked by the NCAA, while the remaining study reported research about injury prevention programs in the literature but did not include information on injury reporting systems (Junge and Dvorak 2004).

BASEBALL/SOFTBALL

One study and 2 websites were identified with information on baseball injuries. The study was a systematic review that investigated whether preseason screening of shoulder range of motion (ROM) was associated with shoulder and elbow injuries in baseball and softball players (Pozzi et al. 2020). This 2020 review by Pozzi et al. included a total of 15 studies; 12 (80%) of which were related to baseball. Of the 12 baseball focused studies, 5 involved professional athletes. The authors of these 5 studies utilized various injury tracking methods that included reporting by athletic trainer or physician or internet databases. The remaining 7 studies involved youth or high school baseball players; injury reporting involved Athletic Healthcare System Daily Injury Report form and Simtrack Mobility System, questionnaires, weekly emails, or injury diaries (Pozzi et al. 2020). Additionally, MLB injury information was reported on www.prosportstransaction.com/ and <https://www.rotowire.com/baseball> (Pro Sports Transactions Archive, n.d.; RotoWire, n.d.-a). Pro Sports Transaction for MLB reports type of injury and date of injury for each player. The website Rotowire organizes injury by player name, league, and MLB team, position (RotoWire, n.d.-a). Pro Sports Transaction had limited access, requiring a monthly user fee to access additional content.

BASKETBALL

Three websites were identified with information on basketball injuries, all for professional leagues. The first, www.prosportstransaction.com, reports on National Basketball Association (NBA) injuries, but not on Women’s Na-

TABLE A1. Summary of Included Websites

Name of Website	Web Address	Sport of Interest	Website contained male and/or female athlete injury information
Pro Sports Transactions	www.prosportstransactions.com/	Soccer, Baseball, Basketball, Hockey	Male only
RotoWire	www.rotowire.com/	Baseball	Male only
Covers	www.covers.com/	Basketball	Male, Female
Entertainment and Sports Programming Network (ESPN)	www.espn.com/	Basketball	Male, Female
Last Word on Sports	lastwordonsports.com/hockey/category/nhl/injuries/	Hockey	Male only
Hockey Reference	hockey-reference.com/friv/injuries/cgi	Hockey	Male only
Professional Women's Hockey Players Association (PWHPA)	www.pwhpa.com/	Hockey	Female only

TABLE A2. Summary of Included Articles – Method of Obtaining Data for Surveillance of Injuries

Study	Sport of Interest	Level of Play	Method(s) of Injury Data
Forsythe et al. (2022)	Soccer	Professional	Health Athlete (Center Corpe)
Giza et al. (2005)	Soccer	Professional	Manual data collection – required injuries to be reported to league insurance company by team staff
Hunt et al. (2017)	Soccer	Collegiate	Stanford University Athletics Program electronic injury database
Junge et al. (2004)	Soccer	Professional	From primary literature
Sallis et al. (2016)	Soccer	Collegiate	Injury reports compiled by certified athletic trainers
Pozzi et al. (2020)	Baseball	Youth, Adolescent, Collegiate, Professional	Injury tracking methods including questionnaires, reporting by the athletic trainer or physician or physical therapist of the athlete, athletic trainer databases, weekly diary about injury status maintained by the athlete, and Athletic Healthcare System Daily Injury Report form and Simtrack Mobility System
Abbott (2014)	Hockey	Collegiate	Injury Surveillance Program
Agel et al. (2010)	Hockey	Collegiate	Injury Surveillance Program
Anderson et al. (2019)	Hockey	Collegiate, Professional	Daily self-report from Olympic Committee's Head Physicians "standardized reporting strategies", by team physicians, observation, etc.

tional Basketball Association (WNBA) (Pro Sports Transactions Archive, n.d.). Two other websites, <https://www.covers.com/> and <https://www.espn.com/>, reported on injuries sustained by both male and female basketball players within the NBA and WNBA, respectively (Covers 2022; Entertainment and Sports Programming Network (ESPN), n.d.). Injuries reported by Covers as well as ESPN were organized by NBA or WNBA team. ESPN's injury data was organized by position, date of injury, and injury status. Additionally, there was a section for miscellaneous comments for each player's injury such as location of in-

jury, procedure status, and expected recovery time. However, these two databases included only current injuries; meaning, information is removed from the site once the player recovers, thereby only serving as a transient reporting system.

HOCKEY

Four websites and 3 studies with information on hockey injuries were identified, all for professional leagues. Injuries that occurred in the National Hockey League (NHL) were

reported on www.prosportstransaction.com/ (Pro Sports Transactions Archive, n.d.). The 2 other websites were <https://lastwordonsports.com/hockey/category/nhl/injuries/> and <https://www.hockey-reference.com/friv/injuries.cgi> (Last Word On Hockey (LWOS), n.d.; Hockey Reference, n.d.). The Last Word on Sports (LWOS) website reports injuries dating back one year; whereas, other reporting pages such as ESPN, maintained a weekly or current injuries report (Entertainment and Sports Programming Network (ESPN), n.d.; Last Word On Hockey (LWOS), n.d.). The website Hockey Reference has relatively extensive information for each player, including detailed game statistics, injuries, and draft history/information (Last Word On Hockey (LWOS), n.d.). The lack of guidance through the Hockey Reference website made it difficult to quickly identify each player's current and/or past injuries. On this site, each player must be individually searched to find their injury information, rather than having access to a page that compiles all injuries associated with a specific player and relevant injury updates (Hockey Reference, n.d.). The website was contacted for further assistance on navigating the site; however, no response was obtained. No databases or information on injuries was found for female professional hockey players and there was no information regarding long-term injuries. One website, <https://pwhpa.com>, had a player directory for female professional hockey players (Professional Women's Hockey Players' Association 2023). This included injury reports, Twitter posts, and news articles, but no injury database or surveillance system was identified.

Of the 3 studies identified for hockey injuries, 2 discussed injuries at the NCAA level, which has an Injury Surveillance Program for both male and female athletes. The Injury Surveillance Program was referenced by both studies (Abbott 2014; Agel and Harvey 2010). The remaining study was a clinical review that identified pertinent data regarding ice hockey injury epidemiology and prevention at various levels of competition (Anderson et al. 2019). The review included studies that evaluated injuries sustained by hockey players at different levels of competition (e.g., professional, youth, high school, junior, and college). Among the studies referenced, data was obtained via the following methods: daily self-report from Olympic Committee's Head Physicians "standardized reporting strategies", team physicians, and observation. No publicly available injury surveillance system was mentioned (Anderson et al. 2019).

DISCUSSION

The purpose of this study was to provide a detailed summary of the current publicly available primary and secondary literature, databases, and websites reporting sports-related injuries among male and female collegiate and professional athletes in the U.S.A. to determine whether a gender disparity exists. At the collegiate level, the Injury Surveillance Program has been developed to track sport-related injuries and medical conditions within the NCAA for Division I through III teams. Among the 4 included studies, various methods were used to obtain informa-

tion about injuries in male and female collegiate and professional athletes: manual data collection, questionnaires, daily self-reports by the athletic trainer, physician, or physical therapist, athletic trainer databases, Athletic Healthcare System Daily Injury Report form, and Simtrack Mobility System. Injury surveillance information was identified for male professional athletes in the 7 included websites. However, no publicly available injury surveillance information exclusively for female professional athletes was identified.

SOCCKER

Soccer is the most popular sport in the world, with 200,000 professional players and 240 million amateur players. Injuries in soccer players predominantly involve the ankle, knee, and muscles of the thigh and calf (Gilchrist et al. 2008; Hartmut et al. 2010). Junge and Dvorak reported approximately 20-25% of all injuries are reinjuries of the same type and are in similar or identical areas (Junge and Dvorak 2004). Given the repetitive nature of injuries in soccer players, comprehensive injury records are essential to inform the best course of treatment and identify risk factors in these athletes (Amason 1996; Lin et al. 2018). Professional athletes have access to top-tier facilities and the highest level of care to manage their injuries. Nonetheless, every male professional soccer player sustains at least one performance-hindering injury every year (Junge and Dvorak 2004). During a recovery period from a performance-hindering injury, injury history, severity and diagnosis of injury, and previous treatments are crucial in developing individualized treatment and recovery plans based on similar previous injuries.

For male soccer players at the professional, collegiate, and high school level, injury information is widely available in databases such as Health Athlete for MLS, Injury Surveillance Program for NCAA, High School RIO (Forsythe et al. 2022; Datalys Center 2023). These databases log injury diagnosis, severity, recovery time, matches missed due to injury, and other relevant information. Collegiate athletic trainers and healthcare providers can reference these records when assessing the current injury and compare them to prior treatment histories.

While the number of professional or semiprofessional female soccer players have more than doubled from 2013 to 2017, growing from 1,680 to 3,572, there remains limited information about injuries sustained by these athletes (Alahmad et al. 2020; Sallis et al. 2001). Recent evidence indicates similar injury incidence rates among men and women soccer players, ranging from 10-35 per 1000 game hours for men and 9.1-24 injuries per game hour for women (Alahmad et al. 2020). However, unlike male players, whose injury histories are well-documented in multiple databases, female athletes often rely on independent surveys, questionnaires, and informal logging of information for data collection (Giza et al. 2005).

BASEBALL/SOFTBALL

Similar to soccer, there is a significant lack of literature discussing injury history among female softball players, despite over 2 million female athletes participating in competitive softball leagues at the youth, collegiate, and professional levels (Patel et al. 2021). Injuries in softball occur at a higher frequency than baseball, partly due to the nature of softball tournaments. Youth athletes may take part in 9-12 games over a 3-day span, requiring 18-36 hours of actual play time. Additionally, softball pitchers may easily throw 70-140 pitches over a 3-4 day tournament, compared to youth baseball pitchers, who are limited to 210 pitches per week (Smith et al. 2015). This high volume of physical exertion increases the risk of sustaining sports-related injuries among female softball players.

Softball injuries are often categorized as pitching and non-pitching injuries. For instance, in a sample of 156 youth softball players, about 18% reported pitching injuries, while 45% of injuries were from fielding, 21% to base-running, and 18% to hitting (Smith et al. 2015). Lower extremity injuries, often stemming from either acute incidents or exacerbation of an ongoing condition, are also common (Patel et al. 2021). However, information related to softball injuries is primarily collected through individual questionnaires and self-report surveys (Smith et al. 2015). Unlike men's baseball, which benefits from established databases and records containing detailed injury information, female softball players lack comparable resources. Existing injury data for men's baseball includes publicly accessible websites and specialized databases that provide insights into injury types, severity, games missed, and recovery timelines. In contrast, research on female softball injuries often requires researchers to develop their own data collection methods, such as surveys and unique record keeping methods (RotoWire, n.d.-b; Patel et al. 2021; Pozzi et al. 2020; Pro Sports Transactions Archive, n.d.; Smith et al. 2015). The absence of a unified methodology or comprehensive databases for female professional softball players in the U.S.A. highlights this disparity in injury tracking and data availability between male and female athletes.

BASKETBALL

Basketball is played by male and female athletes of all ages and skill levels. Historically, women's injury frequency in basketball has been 1.6-times that of men across all levels of basketball (Zelisko et al. 1982). The Women's National Basketball Association (WNBA) was created in 1997, and since its inception, comparisons between NBA and WNBA players have been commonly made. Regarding injury, female athletes are more likely to have a higher overall game-related injury rate (24.9 per 1000 athlete exposure) compared to their male counterparts (19.3 per 1000 athlete exposure) (Deitch et al. 2006). Furthermore, women basketball players sustained more lower-extremity injuries (14.6 per 1000 athlete exposures) compared to their male counterparts (11.6 per 1000 athlete exposure), with ankle injuries being the most common. Similarly, a study performed by Zuckerman et al. confirmed that women are more likely

to sustain lower extremity injuries compared to men (Zuckerman et al. 2018). The authors used a database that provided injury history for student athletes from 2009 to 2015. Approximately 59% of lower extremity injuries occurred in women's college basketball players compared to 54.9% of men's college basketball players (Zuckerman et al. 2018).

There are significant gaps in available databases for injuries sustained by female professional basketball players (i.e., WNBA), while injuries at the collegiate level are often documented and maintained by the athlete's institution. However, these records are rarely accessible to healthcare providers, researchers, or even the athletes themselves. At the professional level, major independent and sports media companies have developed websites to house injury information; however, there is very limited publicly accessible information related to injuries sustained by WNBA players. Websites, such as Covers and ESPN, only present current injury information, without context as to time missed, recovery, and expected return date (Covers 2022; Entertainment and Sports Programming Network (ESPN), n.d.). This warrants the need for comprehensive injury information, which will help develop guidelines or protocols for recovery as well as prevention of future injuries. Furthermore, logging injury information for non-professional women's basketball players is also important. As previously mentioned, collegiate players' injury history is typically recorded and stored by their school/university or using independent team records, both which are difficult for non-affiliated members to access. The lack of access to injury information makes it especially difficult for other health care providers and researchers to understand the athlete's injury history, making it challenging to develop treatment plans, and report common injury trends among women's basketball players.

HOCKEY

Ice hockey is a fast-paced, high-collision sport, with one of the highest injury rates in all organized sports (Popkin et al. 2017). These injuries predominantly involve the face, head, and neck, with most resulting from contact with another player. Such injuries typically manifest as concussions, which can result in major difficulties in an individual's daily functioning and activities (Bloom et al. 2021). Concussions symptoms can appear as physical, cognitive, emotional issues and can interfere with sleep (Asken and Rabinovici 2021; Polinder et al. 2018). Oftentimes, without proper concussion management, athletes may return to their sport before symptoms have resolved, which can ultimately lead to reinjury or exacerbation of current symptoms (Asken and Rabinovici 2021; Wilson et al. 2020). This highlights the need for a comprehensive database to inform a safe return to hockey. If information about current symptoms and records of symptom progression are available, this will allow members of the sports medicine team to accurately assess athletes' injury symptoms before allowing them to return to playing hockey.

The type of information available via databases for injuries sustained by male and female hockey players varies considerably. Some websites, such as hockey-reference.com

provide details about current injuries (Hockey Reference, n.d.). This database provides the current date of injury, broad information about types of injury, and a note section that typically discusses the outlook of the injury on the remainder of the hockey season. However, most information available pertains to men's hockey at the professional and semi-professional level.

Female ice hockey is a growing sport. The Professional Women's Hockey Players Association was founded in 2019 to promote and advocate for professional women's ice hockey (Professional Women's Hockey Players' Association 2023). This includes advocating for equal pay and benefits, publicizing the sport, and providing women athletes with the same resources, training facilities, and recovery opportunities as men's ice hockey players. However, one area that has been overlooked is a database for women's hockey injuries. While injury data for professional women's hockey players is limited, injuries sustained at the collegiate level are reported via the NCAA Injury Surveillance Program. In 2019, Crowley et al. used the NCAA Injury Surveillance Program to evaluate the epidemiology of foot and ankle injuries in female collegiate ice hockey players between 2004-2014 (Crowley et al. 2019). The authors found that almost 45% of women hockey players sustained some form of lower extremity injury during their season.

Despite a high risk of injury in women's hockey, there still seems to be a lack of databases and records that report injury history information. Women players are just as likely to be injured as men's hockey players; therefore, it is imperative that women's players also have their injury history adequately recorded. This will inform a safe return to sport and minimize the risk of reinjury or worsening of pre-existing symptoms. Professional women's hockey leagues can serve as an example for the integration of injury databases into women's sports. Due to the league being relatively new compared to other historic sports leagues, they are in a position where they may be able to adjust to procedural changes. The implementation of a formal injury database would allow other leagues to see the impact and benefit it has on the players and team providers.

LIMITATIONS

There are several limitations to this study. Considering this study required the reviewers to systematically search PubMed and for websites, the resulting papers and websites were reviewed based on the outlined methods section. There may have been other studies that could have represented additional methods of tracking injuries in male and/or female athletes at the professional or collegiate level. There may have been other databases or health systems that exist that are only known and used by healthcare professionals or team doctors of the athletes that are not publicly accessible. It was difficult to access information regarding websites that required paywalls, potentially leading to the underrepresentation of smaller, less prominent databases that may not have been included due to these access barriers. These were not reported. This narrative review did not utilize a blinded methodology; as such, reviewers were aware of the included studies and websites during the selection and extraction process. Additionally, this study is limited to one country, which is the U.S.A. Moreover, the scope of the study is restricted to specific sports, including soccer, baseball/softball, basketball, and hockey.

CONCLUSION

This study assessed the availability and gender disparity of injury databases for collegiate and professional athletes in the U.S.A. While male athletes have injury surveillance programs across various sports, comparable databases for female athletes are lacking. This finding highlights the need for comprehensive injury databases for female athletes, given their increasing participation rates and comparable injury risk to male athletes. Expanding access to injury data for female athletes would aid in tracking risk ratios, creating injury prevention programs, developing treatment protocols, and evaluating outcomes following injury – crucial for healthcare providers and researchers. Adapting existing systems, or creating accessible, filterable databases or websites could be vital for effective, targeted prevention and treatment strategies.

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