Shoulder Injuries in Sports: A Systematic Review

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Abstract

Introduction: The purpose of this study was to, present and discuss the accumulated knowledge involvement in various shoulder injuries and highlights the clinical implications for the evaluation and treatment of shoulder injuries .Shoulder injuries are common in both athletes and non-athletes. We seek to summarize the causes of shoulder injuries in athletes. The aim of this study was to determine the incidence of shoulder injuries with the aim of recognizing and preventing this injury in all sports. **Materials and Methods**: A search of 4 databases according to PRISMA guidelines from 2000 to 2020 was performed using keywords related to the causes of shoulder injuries and a review of all available manuscripts was performed. In this study, a total of 2800 articles were reviewed in the initial stage and according to the inclusion criteria, among all the independent variables that were analyzed the number of articles with inclusion criteria reached 22. **Result**: This systematic review highlights important risk factors for shoulder injuries in all sports. Prevention is an existing topic, but the small numbers of studies published on that topic in the literature and the important variability of the quality of the studies included in this systematic review show that risk factors of shoulder injuries in sports are still not completely demonstrated. The true efficiency of prevention programs to limit shoulder injuries in different sports must also be further investigated. Evidence suggests that shoulder injuries are more common in young men, professional athletes, and in impact sports. **Conclusion**: There is no specific study on shoulder injury in various sports. This study shows that the increased risk of shoulder injuries in young men is mainly related to sports injuries. Men are more prone to upper limb injuries. It is seen more in professional sports than amateur and in contact sports more than non-contact sports.

Keywords: Athlete; Injuries; Review; Shoulder; Sport

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Introduction

The shoulder complex, composed of the clavicle, scapula, and humerus, is an intricately designed combination of four joints, the glen humeral (GH) joint, the acromio clavicular (AC) joint and the sterno clavicular (SC) joint and a "floating joint", known as the scapula thoracic (ST) joint.

The GH, AC and SC joints link the upper extremity to the axial skeleton at the thorax. The ST joint allows for the scapula to glide over the contours of the posterior thoracic wall. All four joints work collectively together to achieve normal shoulder girdle movements (1). Movements of the shoulder complex represent a complex dynamic relationship between muscle forces, ligament constraints, and bony articulations. The articular structures of the shoulder complex, in particular the GH Joint, are designed primarily for mobility, allowing us to move and position the hand through a wide range of space, allowing the greatest range of motion of any joint in the body (1, 2).

The freedom of movement has been developed at the expense of stability (commonly known as the mobility-stability trade-off), and it is these competing mobility and stability demands, combined with an intricate structural and functional design, which makes the shoulder complex highly susceptible to dysfunction and instability (ultimately to injury). The shoulder demonstrates a unique functional balance between mobility and stability through active forces, known as dynamic stabilization, which is the reliance

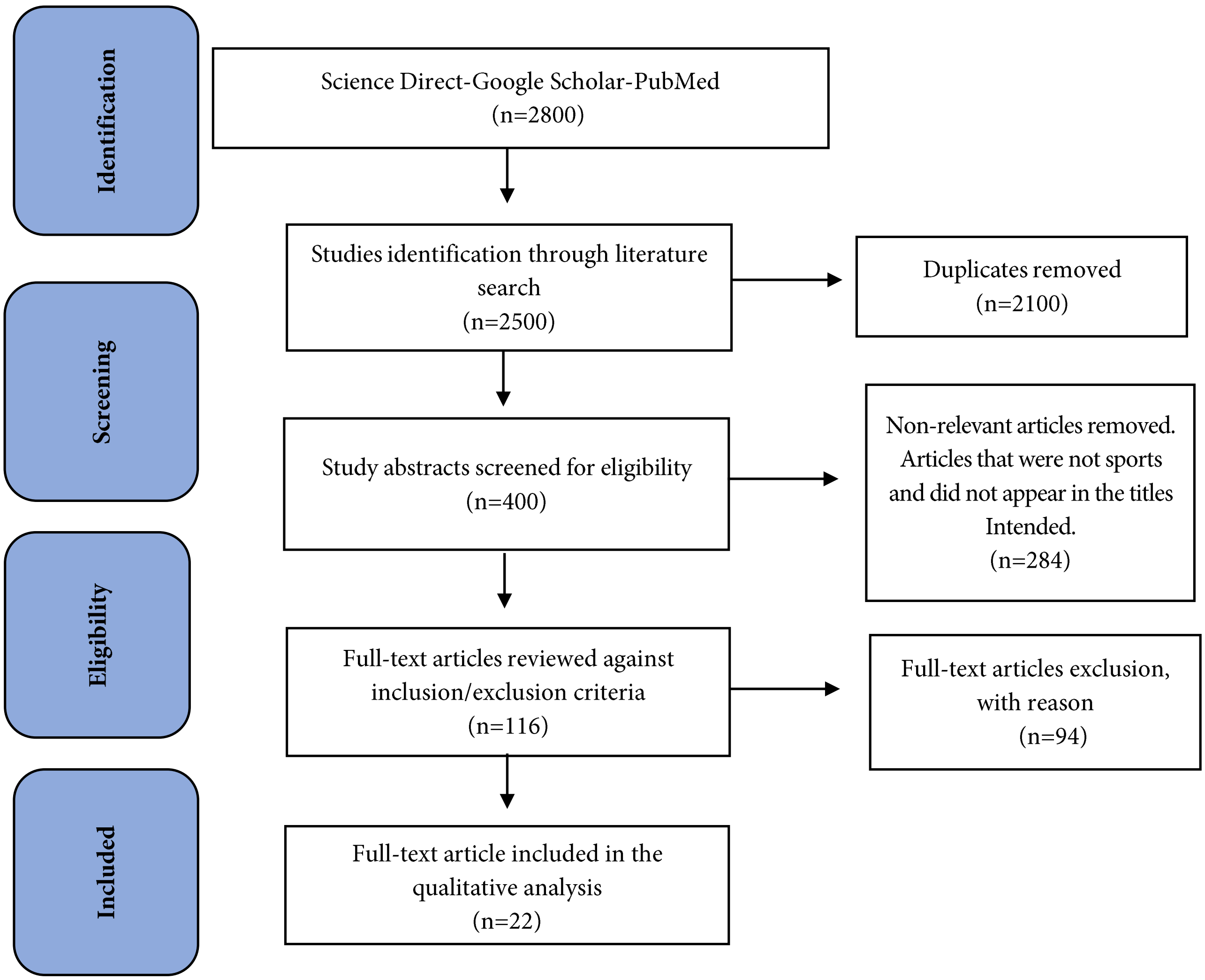

Figure 1.PRISMA flow diagram

on active forces or dynamic muscular control rather than passive stabilization through passive forces such as articular surface configuration, capsuleor ligaments. Thus within the shoulder complex, it is muscle forces which serve as the primary mechanism for securing the shoulder girdle to the thorax and providing a stable base of support for upper extremity movements (1, 2).

Sports injuries are injuries that occur during sport, athletic activities, or exercising. When an athlete complains of pain or an injury, the key to a diagnosis is to obtain a detailed history and examination. Another important aspect of sport injury is prevention, which helps to reduce potential sport injuries.

More than a third of sports injuries involve the upper extremity (3).

ACJ injury has been reported as the most common upper extremity injury in sports and the one most frequently leading to time loss from sports (4-6).

Shoulder injuries are of particular interest because of the high prevalence of self-reported shoulder pain in the general population (7, 8)and the association of these symptoms with reduced health, limitations in daily living and absenteeism (9, 10).

Objectives

The purpose of this study was to provide an analysis of all available studies on shoulder injuries in various sports. Given the wide range of studies, we have a particular focus on the critical evaluation of all studies, including methodological quality and risk of bias. Based on the results, we want to assess the tendency of whether recognizing shoulder injuries helps to prevent them. The present study is a review to determine the incidence of shoulder injuries with the aim of preventing this injury in all sports.

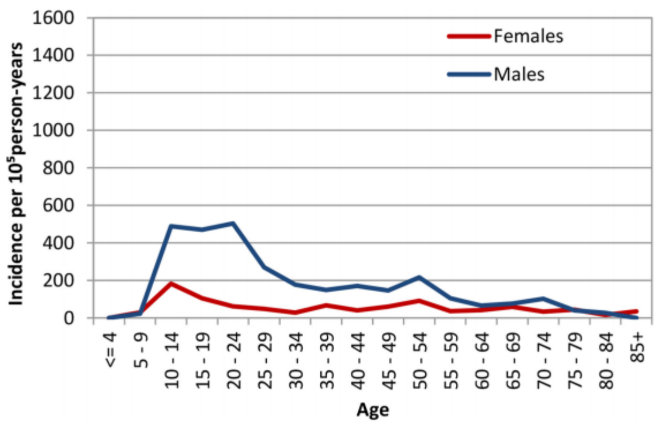

Figure 2. Age and gender

Materials and Methods

Eligibility criteria and search strategy:

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist was used to gauge the quality of this systematic review.

To obtain relevant literature on types of shoulder injuries in different sports, abstracts and citations were identified through a search using the Science direct, Google scholar, PubMed search engines from2000upto2020 articles published in English and in peer reviewed journals were considered for the review. The initial search focused on finding literature using shoulder injuries.

Search terms included "shoulder injuries", "shoulder injuries in sports Olympics", "Shoulder complex injuries", "shoulder injuries in sport or sedentary", "shoulder injuries in contact and non-contact sports", "shoulder injuries in elite and amateur sports", "shoulder injuries between overhead throw and other sport", "shoulder injury in Professional and amateur sports", "shoulder injury amateur players" in various combinations. In the first stage of screening, titles and abstracts of identified articles were checked for relevance. In the second stage, full-text articles were retrieved and considered for inclusion and duplicate articles were removed. In the final stage, the reference lists of retrieved full-text articles were searched for additional articles. The summary of this process is presented in Figure 1.

Full-text evaluation led to the elimination of items that did not meet the inclusion criteria and 22 articles were included in the final analysis.

Data extraction and assessment of methodological quality

Data from each study were collected and entered manually into Excel: year of publication, purpose, gender, age, number of athletes, and results.

Statistical analysis

Due to the consideration of different criteria in the study design, data collection methods and formats of injury reporting, performing a meta-analysis of the presented data was very difficult. Qualitative variables are reported as absolute and relative frequency (%). Injury outcomes are depicted separately for different groups.

Results

Study Characteristics

By examining studies in different groups, it seems that in the group of injuries in sports and non-sports, it was impossible to conclude that the incidence of shoulder injuries is definite due to the small number of studies in this field. In professional and amateur athletes, the incidence of injury is higher in professional athletes. In the group of contact and non-contact sports, the results indicate that the incidence of injury in contact sports is higher than non-contact. By examining the articles in the age and sex groups, the incidence of injury was seen in young men.

Shoulders complex injuries

The human shoulder is the most mobile joint in the body (11). This mobility provides the upper extremity with tremendous range of motion such as adduction, abduction, flexion, extension, internal rotation, external rotation, and 360° circumduction in the sagittal plane. Furthermore, the shoulder allows for scapular protraction, retraction, elevation, and depression. This wide range of motion also makes the shoulder joint unstable (11). This instability is compensated for by rotator cuff muscles, tendons, ligaments, and the glenoid labrum (12).

The shoulder is structurally and functionally complex as it is one of the most freely moveable areas in the human body due to the articulation at the glen humeral joint. It contains the shoulder girdle, which connects the upper limb to the axial skeleton via the sterno clavicular joint. The high range of motion of the shoulder comes at the expense of decreased stability of the joint, and it is prone to dislocation and injury (13).

Sport and non-sport related shoulder injuries

In the study of Enger *et al.* twenty-nine per cent (n=78) of 2650 registered shoulder injuries were reported to be sports-related, with the highest proportion in acromio clavicular injuries (>50%). Patients with sports injuries were younger than those injured during other activities (median age 28 and 43 years, respectively, P<0.001), and more often male (78% and 52%, respectively, P<0.001). There was a strong gender disparity in incidence of sports-related shoulder injuries in adolescents and young adults, which was not observed in non-sports shoulder injuries (14).

Table 1. Investigations related to shoulder injuries

Research fellow	Purpose	Subject	Age	Result
Kevin Laudner *et al.* (15)	To determine the incidence of shoulder injuries among NCAA Division I overhead athletes and to determine the types of shoulder injuries most common among specific overhead sports, such as swimming, baseball, softball, tennis, and volleyball.	371 male and female (male=152, female = 219)	…	Shoulder injuries were documented in 30% of the intercollegiate overhead athletes at some point during their athletic careers with volleyball players experiencing the highest incidence of shoulder injuries among the five sports
John E.Bonza *et al.* (16)	(1)Calculate shoulder injury rates during the 2005–2006 and 2006–2007 academic years, (2) Describe shoulder injury patterns, and (3) Compare shoulder injury rates and patterns by sport and sex.	805 shoulder injuries (boy-Girl)	High school	High school shoulder injury rates and patterns varied by sport. Continued surveillance is warranted to understand trends and patterns over time and to develop and evaluate evidence-based preventive interventions.
Renee Sytema, MD *et al.* (3)	To analyze differences in characteristics of sports injuries of the upper and lower extremity and to identify those factors that contribute to the risk of sustaining an upper extremity injury relative to the risk of suffering a lower extremity injury	25,120 patients with a simple sports injury	…	A high percentage of sports injuries are sustained to the upper extremity. Different risk factors were identified for both sexes. These risk factors should be taken into account when designing preventive measures.
Mohamed Souhaiel Chelly *et al.* (17)	To examine the activity profile of elite adolescent players during regular team handball games and to compare the physical and motor performance of players between the first and second halves of a match	18 male team handball players	Age: 15.1±0.6years	Coaches should seek to sustain performance in the second period of a game by modifying playing tactics and maximizing both aerobic and anaerobic fitness during training sessions
G. Myklebust *et al.* (18)	Cross-sectional study was to describe the prevalence and consequences of painful shoulder conditions among elite female handball players.	179 players from all 12 teams of the Norwegian elite league	…	A high proportion of elite female handball players suffer from a painful and/or unstable throwing shoulder. The pain substantially affects training and competition, although they continue to play with shoulder pain.
James Crichton *et al.* (19)	Elucidate common mechanisms of injury and identify the patterns of injury they produce	Twenty-four elite rugby players	Aged 19–35	Greater understanding of the mechanisms involved in rugby shoulder injury is useful in understanding the pathological injuries, guiding treatment and rehabilitation and aiding the development of injury-prevention methods
Benjamin Clarsen *et al.* (20)	To determine whether rotator cuff strength, glen humeral joint range of motion and scapular control are associated with shoulder injuries among elite male handball players	A total of 206 players in the Norwegian elite handball league for men were tested prior to the 2011–2012 season.	…	Injury prevention programs should incorporate interventions aimed at improving glen humeral rotational range of motion, external rotation strength and scapular control.
T. Walker Robinson *et al.* (21)	To describe shoulder injuries in a nationally representative sample of high school athletes playing 9 sports. A national estimate of shoulder injuries among high school athletes was subsequently calculated	For the 9 sports included in the study since 2005–2006 (boys' football, boys' and girls' soccer, girls' volleyball, boys' and girls' basketball, boys' wrestling, boys'	High schools	High school shoulder injury rates and patterns varied by sport and gender. Prospective epidemiologic surveillance is warranted to discern trends and patterns to develop evidence-based interventions to prevent shoulder injuries.

		baseball, and girls' softball)		
StigHaugsboe Andersson *et al.* (22)	Effect of an exercise programme designed to reduce the prevalence of shoulder problems in elite handball	45 elite handball teams/22 female teams, 23 male teams, 660 players	…	The OSTRC shoulder injury prevention programme reduced the prevalence of shoulder problems in elite handball and should be included as a part of the warm-up.
StigHaugsboeAndersson *et al.* (23)	To assess whether previously identified risk factorsare associated with overuse shoulder injuries in a largecohort of elite male and female handball players.	329 players (168 male, 161 female)	…	None of the previously identified risk factors were associated with overuse shoulder injuries in a mixed-sex cohort of elite handball players
Martin Asker *et al.* (24)	To investigate whether shoulder function changes during the competition season and whether the physical profile of the players changes during their time in secondary school.	Shoulder injuries in adolescent male and female elite handball players studying at handball-profiled secondary schools in Sweden	Aged 15 to 19	The results from this study on risk factors for shoulder injuries will therefore be of importance for current athlete screening, load monitoring, injury management and future injury prevention in the sport and possibly in other overhead sports as well.
Martine Enger *et al.* (25)	To obtain an overview of shoulder injuries in a general population cohort, and to estimate the relative proportion of the main injury categories soft tissue injuries, fractures and dislocations, as well as their variation with age and gender.	3031 shoulder injuries were registered from May 2013 through April 2014	The median age was 37 years (51 years in women and 31 years in men)	Which shoulder structures that are affected by injury vary substantially with age and gender .The shoulder injury incidence rates of young men and the elderly are high.
Patricia R. Melvin *et al.* (6)	To describe the epidemiology of UE injuries among collegiate male and female ice hockey players with NCAA (NationalCollegiate Athletic Association) injury surveillance data from 2004-2005 to 2013-2014.	…	…	Men and women sustained a significant number of UE injuries playing collegiate ice hockey during the period studied, with acromioclavicular joint sprain being the most common UE injury and the one that most frequently led to significant time loss.
ChristerAasheim *et al.* (26)	To record overuse injuries among male juniorhandball players throughout a handball season.	Ten Norwegian junior male handball teams(145 players)	aged 16–18 years	Interventions to prevent overuse injuries among male junior handball players should focus on these areas.
Martin Asker *et al.* (27)	To assess the prevalence of shoulder problems among adolescent elite handball players and to investigate potential differences in gender, school grade, playing position and playing level.	471 players/54% female	Age 15-18 years	Highlight the importance of introducing a clinical monitoring programme on a routine basis and improving the medical support, taking gender-related aspects into consideration, at handball-profiled secondary schools.
Akira M. Murakami *et al.* (28)	To use Magnetic Resonance Imaging (MRI) to characterize the severity, location, prevalence, and demographics of shoulder injuries in athletes at the Rio de Janeiro 2016 Summer Olympic Games.	A total of 11,274 athletes which included 5089 women (45%) and 6185 men (55%)	Average age of 26 years, ranging from 18 to 34	The high rates of bursal, rotator cuff, and labral pathology found in these patients implies that some degree of glenohumeral instability and impingement is occurring, likely due to fatigue and overuse of the dynamic stabilizers
MyoungGi On *et al.* (29)	To describe and analyze the shoulder injuries in elite athletes during the 2018 Winter Olympics in Pyeongchang	11 men, 3 women	Range, 17 to 32 years	The most common diagnosis was contusion (n=6), followed by rotator cuff injuries (n=3), superior labrum from anterior to posterior lesion (n=1), sprain (n=1), acromioclavicular-coracoclavicular injury (n=1), dislocation (n=1), and fracture (n=1).

Martine *et al.* (14)	To quantify and describe sports-related shoulder injuries in an urban population	Shoulder injury in all cases admitted during 1 year in a combined primary care and orthopedic emergency department serving	28 and 43 years	The comparison of sport to non-sport shoulder injury incidence rates suggests that the increased risk of shoulder injuries in young males is mainly attributable to sports injuries.
Mohamad Y. *et al.* (30)	To explore the epidemiological patterns of shoulder injuries in professional baseball.	The transaction lists of the 'Major League Baseball' website were screened for injuries from 2011 to 2016, inclusive.A total of 3090 injuries were recorded.	…	The overhead pitching motion puts the shoulder at risk and accounts for the high incidence of its injuries.
Laura M. Schwab *et al.* (31)	To investigate mechanisms of shoulder girdle injuries and their impact on players from the Australian Football League (AFL).	Twenty-four professional male AFL players	(range 18–30) years	Our results may directthe refinement of currently used preventative strategies, such as taping or shoulder strengthening to ensure that they are informed by both the mechanisms of shoulder injury and the ranges of motion in which they occur in this sport.

Close to one-third of all shoulder injuries in the cohort occurred during sports activities. The most common sports associated with shoulder injuries were football, cycling, skiing and martial arts, accounting for 58% of the sports injuries. There were higher proportion of fractures in high energy sports like skiing and cycling. When comparing sport to non-sport injuries, there were no differences in the proportion of injuries that were fractures, dislocations and soft tissue injuries, but there were slightly more collision injuries in sports (14).

Scapular dyskinesia may be the primary instigator in the pathologic process that results in shoulder dysfunction; an associated condition that contributes to injury causation, exacerbates shoulder symptoms, or adversely influences management or outcomes; or an adaptive condition that arises to compensate for other injury or discomfort .The relationship between dyskinesia and shoulder symptoms is not always clear.

In cases of nerve injury, fracture, AC separation, and muscle detachment, the injury creates the dyskinesia, which in turn affects shoulder function. In other cases, such as rotator cuff disease, labral injury and MDI, the dyskinesia may be causative, creating path mechanics that predispose the arm to such injuries. Alternatively, dyskinesia may be a response to injury, creating path mechanics that increase the existing dysfunction (32).

shoulder impingement syndrome (SIS) and glenohumeral joint instability are the most frequent shoulder disorders, much research has been focused on the scapulothoracic motion in patients with these shoulder disorders (33).

The results of the mentioned studies suggest that shoulder injuries are more common in sports than non-sports. However, definitive conclusions are impossible due to few studies in this field.

Overhead throw sport and non-sport

The overhead throwing motion is a skillful movement that can be very stressful on the shoulder joint complex. As a result of the complexity of this movement, the shoulder joint is a common site of injury in the throwing athlete (34).

The shoulder is at high risk for injury during overhead sports, in particular in throwing or hitting activities, such as baseball, tennis, handball, and volleyball (35).

Two Studies show that Shoulder injuries and shoulder pain is substantial problems in overhead athletes, such as baseball and softball pitchers or handball, volleyball, cricket and tennis players. The incidence of shoulder injuries in overhead sports varies between 0.2/1000hours and 1.8/1000hours(36-38).The average proportion of athletes reporting weekly moderate or severe reductions in training volume or in sports performance, or complete inability to participate in sport due to a shoulder problem is 5 % in secondary school male and female volleyball players and 12% in senior elite male handball players (20). Up to 36% of senior elite female handball players report shoulder pain in the early preseason (18).

Risk factors for shoulder injuries might vary among different overhead sports, since athletes participating in contact sports may be at higher risk of traumatic shoulder injuries (39-41). A common feature of overhead sports is the repetitive use of the shoulder with the hand above the head. Consequently, mechanisms linked to non-traumatic shoulder injuries may therefore not differ considerably between overhead sports (42). Biomechanical factors, such as shoulder mobility, coordination and impaired throwing technique, may also be risk factors for shoulder injuries in overhead sports (43-45).

Chronic shoulder pain in the overhead athlete is often attributed to sport-specific adaptations, alterations in strength, flexibility, and posture not only in the glen humeral joint, but also in other links of the kinetic chain(46-49). These alterations change biomechanics and movement strategies during serving and striking, possibly leading to overload injuries at the shoulder. In particular, glen humeral internal-rotation deficit (GIRD), rotator cuff strength imbalance, scapular dyskinesia, thoracic spine stiffness and hyper kyphosis, lumbar core instability, and hip range of motion and strength deficits possibly create the “cascade to injury”, as defined by Kibler (10) and Lintner *et al.* in overhead athletes (48).

Overhead throwing athletes typically present with a unique musculoskeletal profile. The overhead throwing athlete exhibits excessive amounts of motion, which result in an inherently unstable glenohumeral complex, thus requiring the athlete to rely heavily on dynamic stabilization for high-level, symptom-free activity (50).

The rotator cuff plays an important role in dynamic shoulder stabilization and is exposed to tremendous forces during the act of throwing. It is composed of the supraspinatus, infraspinatus, teres minor, and subscapular is muscles. They act in concert as dynamic stabilizers that compress the humeral head against the glenoid, creating a stable arc of motion about the glenohumeral joint throughout the throwing process (51). Insufficiency of the rotator cuff musculature can lead to an alteration in these forces, resulting in shoulder instability, translation of the humeral head, and subsequent altered throwing biomechanics (52).

Pink *et al.* reported that ninety percent of forward propulsion force in swimming is generated by the upper extremity, as it must “pull” the rest of the swimmer’s body over the shoulder (53). Akin to the development of pathological changes in overhead throwing athletes, some posit that repetitive, high-energy overhead stresses at the shoulder result in progressive attenuation of the shoulder’s static stabilizers (capsulo-ligamentous structures), leading to increased laxity as well as potential instability and impingement symptoms if dynamic stabilizers are unable to compensate (54).

Shoulder injuries in overhead athletes are common. Study have demonstrated the repetitive micro traumatic stresses during the throwing motion can lead to chronic soft tissue adaptations in the glenohumeral joints. The repetition of high velocity overhead throwing can change the shoulder stability-mobility relationship and ultimately lead to injury (55).

Athletes are extremely prone to shoulder injuries due to the throwing motion that places significant stress on the glenohumeral joint. The speed generated during the throwing motion is amazing, with rotation occurring about the shoulder at angular velocities of up to 7000°/sec (56, 57). The shoulder’s dynamic and static stabilizers must overcome these tremendous forces to maintain the integrity of the glenohumeral joint. The dynamic stabilizers to the throwing motion include the rotator cuff, scapulothoracic muscles, and the long head of the biceps; the static stabilizers include the glenoid, the glenohumeral joint capsule, and the labrum (56).

Despite the results, there is no agreement on the inherent risk factors for shoulder pain in an overhead athlete.

Years of exercise, body mass index, sex, age and level of play seem to have a moderate effect.

Professional or amateur

The results of Zeitler *et al.* studies showed that, shoulder injuries occurred almost twice as often in amateur athletes than in professionals (overall proportion [95% CI]: amateur athletes: 9% [6%; 12%], professionals: 4% [2%; 8%]) (58).

Zazryn *et al.* published a prospective cohort study of 14 professional and 33 amateur boxers in Victoria, Australia, who were followed up monthly for a period of 12 months. Notably, the authors stated a response rate of 19% for amateurs and 25% for professionals. Providing a detailed description of data acquisition and cohort characteristics, they report an overall injury rate of 2.0 per 1000 hours of boxing (1.0/1000h in amateurs and 4.4/1000h in professionals). They found injury rates to be a lot higher in bouts than in training (1081.1–1221.4 injuries per 1000 bout hours compared to 0.5–1.7 injuries per 1000 hours of training). While competition exposure is given as 2.7 bouts for professionals (range 1.0–5.0) and 3.6 bouts for amateurs (range 1.0–10.0).Injury rates per 100 ghts are also listed for amateurs and professionals separately (25 for amateurs compared to 33.3 for professionals) (59).

Shoulder injuries are highly prevalent among elite male handball players (20).

Rugby code injury rates have been studied prospectively across different countries and levels (60). In elite men’s rugby union, pooled injury incidence has been reported at 81 injuries/1000 player match-hours (60), and at amateur level, 47 injuries/1000 player match-hours (61).Comparatively, in elite men’s rugby league, pooled injury incidence has been reported at 148 injuries/1000 player match-hours (62) and in amateur rugby league, 62 injuries/1000 player match-hours (63).

Studies included in the meta-analysis followed the consensus guidelines definition of an injury (64-66). One study reported incidences for amateur and semiprofessional players (67). In order to accurately report the pooled incidence of injury for amateur players only, the figures reported for semi-professional players were excluded prior to conducting the meta-analysis. The six studies encompassed 2340 match injuries during 104,308 h of match exposure. The overall incidence of match injury in senior amateur rugby union was 46.8/1000 player hours [95% confidence interval (CI) 34.4–59.2].Only one study reported the incidence rate of training injuries, therefore training injuries were not included in the meta analysis. Level of play was reported in four of the studies, with incidence rates separated according to specific levels (65-67).Given the different cohorts used in each study, it was not possible to compare the levels of play between the studies and therefore meta-analysis for this variable was not conducted. Reported separate incidence rates for Senior A ('premier grade' or highest-level amateur) and Senior B (second highest-level amateur) players, with a higher incidence of match injury found in the Senior A players. Similarly, Roberts *et al.* reported a higher incidence of injury in group B (amateur) than group C (recreational and social) (67). While Senior A players had the highest incidence of injury in one study, it was followed by the presidential/social cohort, with the lowest incidence observed in the Senior b/reserve players (65). Conversely, Swain *et al.* separated the incidence of injury into Grades 1-4, with the 3rd Grade reporting the highest incidence, followed by the 4th grade, with the highest level of play (1st Grade) reporting the lowest incidence of injury (66).

A meta-analysis evaluating the incidence of match injuries in senior professional male rugby players found an overall pooled incidence rate of match injuries of 81/1000 player hours (60). In comparison, the incidence in adolescent and youth players has been found to be 26.7/1000 player hours (68). While this is considered to be high in comparison to some sports, such as soccer and basketball, it is comparable with other collision sports, such as ice hockey, Australian Rules football and American football (69, 70). The incidence of injury in the amateur rugby game has been widely reported in various studies, ranging from 5.95/1000 player hours to 99.5/1000 player hours; however, inconsistencies in the methods of data collection and injury definitions used, make inter-study comparisons challenging, conclusion this meta-analysis found that the incidence rate of injury in amateur rugby union players was lower than that in professional players, but higher than the incidences reported in adolescent and youth rugby players (71, 72).

The results indicate that the prevalence of injury in professional boxers is higher in professional athletes than amateur athletes in boxing, rugby, football and basketball.

Age of players

In the study of Enger*et al.* 3031 shoulder injuries were registered from May 2013 through April 2014. The median age was 37 years (range 14 days–102 years), 51 years in women and 31 years in men, 60% were male. The male/female shoulder injury incidence rate ratio in the 20–34 years age group was 3.6. Contrary, the female/male rate ratio above 75 years was 2.1. Almost half of the injuries were soft tissue injuries, 35% were fractures and 17% were dislocations. The age-stratified incidence rates differed substantially in men and women. Fractures dominated in children up to 10 years and in adults over 60 years, soft tissue injuries in the ages between. The highest dislocation incidence rates were found in young males. A rotator cuff tear was diagnosed in 4% of the injuries (25).

The study's results of Zacchilli *et al.* showed that the maximum incidence shoulder injury rate (47.8 [95% confidence interval. 41.0 to 54.5]) occurred in those between the ages of twenty and twenty-nine years; 46.8% of all dislocations were in patients between fifteen and twenty-nine years of age. Dislocations most frequently resulted from a fall (58.8%) and occurred at home (47.7%) or at sites of sports or recreation (34.5%). Overall, 48.3% of injuries occurred during sports or recreation(73).

The study's results of Chillemi*et al.* showed that age between 20 and 39 years and male sex represent significant demographic risk factors for AC dislocation(74).

All shoulder injuries Contrary to the bimodal male distribution with high incidences in the young and the elderly, the female distribution curve presented less variation until the rise in the late seventies. The male/female rate ratio in the 20–34 years age group was 3.6 (95%), whereas the female/male rate ratio in the above 75 age group was 2.1 (95%) (25).

Patients with sports injuries were younger. The median age was 28years (IQR 20–43) compared with 43 (IQR 24–65) in those that got injured during other activities. The patients with a sports-related injury were also more often male (78% in sports vs 52% in non-sports injuries. The OR of the shoulder injury being sports-related in males versus females was 3.3 (95%). When stratifying the overall shoulder injury incidence rates by age and gender, the sports-related rates were highest in young males, whereas the not sports-related rates were highest in the elderly (14).

Lower extremity injuries occurred most frequently in all age groups, except for children younger than 15 years and persons older than 55 years. In these age groups, upper extremity injuries most frequently occurred (P<0.001) (3).

Shoulder structures are affected by injury vary substantially with age and gender. The shoulder injury incidence rates of young men and the elderly are high (25).

Sports-related shoulder injury incidence rates stratified by age and gender (Figure.2) (14).

It seems that there is a major difference in age between young and old people, which is more common in young people.

Contact and non-contact sports

Shoulder injuries are common in many contact and non-contact sports (75). Sports that involve throwing motions have their athletes more susceptible to this type of injury (76). These injuries are often debilitating knowing that there is more movement in the shoulder joint than in any other joint in the body. Shoulder injuries often lead to significant hindrance in shoulder movement, a general lack of stability in the throwing athlete (77) and musculoskeletal pain (55).

Shoulder injuries constitute a small subset of all injuries at the Olympic Games, however the pain associated with even chronic conditions such as tendinosiscan result in significant pain symptoms (78). The relative lack of osseous restraint within the glen humeral joint allows for the mobility and flexibility required for high level athletic performance. However, it also places a high physical demand on the static and dynamic stabilizers of the shoulder, particularly in athletes at this level. Overuse injuries to the rotator cuff and shoulder girdle muscles as well as to the labrum, joint capsule and cartilage can result in instability and impingement of the joint, impeding performance (79).

In the study of Benza*et al.* it was shown thatcommon mechanisms of shoulder injuries included player-to-player contact (57.6%), contact with the playing surface (22.8%), no contact (*eg*, improper shoulder rotation) (10.0%), overuse/chronic (4.6%), and contact with a playing apparatus (*eg*, tackling dummy, soccer goal, basketball hoop) (2.9%). Player-to-player contact was the primary mechanism for shoulder injuries that required surgery (59.8% of shoulder injuries requiring surgery), followed by contact with the playing surface (20.0%) (80).

Player-to-player contact accounted for 58.0% of injuries resulting in more than 3 weeks of time loss. Player-to-player contact resulting in shoulder injuries was most frequently seen in football (76.2% of all football shoulder injuries), girls' basketball (66.6%), wrestling (59.5%), and boys' soccer (53.2%). Shoulder injuries that resulted from contact with the playing surface were most common in girls' soccer (87.7%), boys' soccer (45.8%), wrestling (30.5%), and girls' basketball (24.6%). Noncontact shoulder injuries were most commonly seen in baseball (43.7%), volleyball (37.2%), softball (30.2%), and boys' basketball (13.9%). Shoulder injuries caused by contact with a playing apparatus were most common in boys' basketball (30.2%) and volleyball (26.3%). Sprains/strains were frequently caused by player-to-player contact (50.1%), contact with the playing surface (23.5%), and no contact (17.1%). Dislocations/separations were frequently caused by player-to-player contact (64.1%) and contact with the playing surface (29.5%). All contusions resulted from either player-to-player contact (83.8%) or contact with the playing surface (16.2%). Similarly, all fractures resulted from player-to-player contact (56.7%) or contact with the playing surface (42.3%).

Common mechanisms of shoulder injury included player-to-player contact (57.6%) and contact with the playing surface (22.8%)(80).

Handball is an Olympic team sport that includes both physical contact and frequent overhead throwing, which stress the shoulder girdle(17, 81).

Shoulder injuries are extremely prevalent in collision athletes and comprise up to 80% of injuries sustained in contact sports such as rugby (82).

The most recognizable examples of contact sports are North American football and rugby. American football and rugby have been found to have the highest injury rate, and shoulder injuries comprise 66.1% and 80% of all injuries in these sports respectively (83).

Also notable that the number of injuries increases in the second half of the game (84). The shoulder is the most commonly dislocated joint in the human body and 65% of primary shoulder injuries in contact sports involve a glenohumeral dislocation. The incidence of anterior dislocation is as high as 7% in athletes competing in ice hockey at any level (85).

Both contact and throwing athletes put considerable stress on their rotator cuff tendons. In up to 32% of contact shoulder injuries there can be some form of concomitant rotator cuff pathology (86).

Australian Rules football is a fast-paced and physically demanding contact sport that places high stresses on the shoulder joint complex due to the demands of overhead playing and multi- directional tackling (31).

Studies show that shoulder injuries are very common in contact sports.

Gender

In the study of Andersson*et al.* 45 elite handball teams (22 female teams, 23 male teams, 660 players) were cluster randomized (22 teams, 331 players in the intervention group, 23 teams, 329 players in the control group) and followed for 1 competitive season (7 months).The average prevalence of shoulder problems during the season was 17% in the intervention group (female) and 23% in the control group (male), (mean difference 6%). The average prevalence of substantial shoulder problems was 5% in the intervention group (female) and 8% in the control group (male), (mean difference 3%). Using generalized estimating equation models, a 28% lower risk of shoulder problems and 22% lower risk of substantial shoulder problems were observed in the intervention group (female) compared with the control group (male) (22).

Female players had a significantly higher prevalence of both any shoulder problems and substantial shoulder problems during the follow-up period. These results are in line with the finding from a recent study on Norwegian senior elite handball players where a higher season prevalence of shoulder problems was reported in female players (26%) compared to male players (20%) (23).A similar gender-related difference was also reported in Brazilian senior elite players where 9% of the female players reported traumatic shoulder injuries compared to 3% of the male players (87).Interestingly, similar gender-related differences, with higher rates identified for females, have also been identified for other injuries in team sports such as concussion (88), and anterior cruciate ligament ACL injury (89, 90).

However, a recent study on youth handball players did not find any gender difference in shoulder injury incidence(37)and Giroto *et al.* reported no differences in the proportion of reported overuse shoulder injuries in Brazilian elite senior players (87). Importantly, there were a higher proportion of female players who reported previous shoulder pain at baseline in our study. Female players may therefore develop shoulder problems at a younger age than do male players, which also would be similar to the relative age effect identified in the ACL injury discrepancy (90). In addition, female players have demonstrated a higher relative workload compared with male players (91), and this could influence the risk of developing shoulder problems. Finally, Serrien *et al.* showed that the throwing kinematics differed between male and female players, where male players showed a higher endo/ecorotation in trunk velocity and higher shoulder horizontal abduction angles during the cocking phase(92). Also, van Den Tillaar *et al.* showed that the maximal endpoint velocities of the hand and wrist segment during throwing were higher in male players, (93) but no other major gender differences in kinematics were found. Gender-related differences in throwing kinematics may thus influence the risk of developing shoulder problems in handball players.

Women sustained more upper extremity injuries (36.9%) than lower extremity injuries (28.2%).For men, this was reversed (63.1% and 71.8%, respectively) (3).

In the study of Owens *et al.* a total of 4080 glenohumeral instability events were documented for an incidence rate of 0.12 injuries per 1000 athlete exposures. The sport with the greatest injury rate was men's spring football, with 0.40 injuries per 1000 athlete exposures. Overall, athletes sustained more glenohumeral instability events during games than practices (incidence rate ratio [IRR], 3.50; 95% confidence interval (6), 3.29-3.73). Male athletes sustained more injuries than did female athletes (IRR, 2.67; 95% CI, 2.43-2.93). Female athletes were more likely to sustain an instability event as the result of contact with an object (IRR, 2.43; 95% CI, 2.08-2.84), whereas male athletes were more likely to sustain an event from player contact (IRR, 2.74; 95% CI, 2.31-3.25). Time lost to sport (>10 days) occurred in 45% of glenohumeral instability events(94).

The study result of Zacchilli *et al.* showed that an overall incidence shoulder injury rate in the United States of 23.9 (95% confidence interval, 20.8 to 27.0) per 100,000 person-years. The male incidence rate was 34.90 (95% confidence interval, 30.08 to 39.73) per 100,000 person-years, with an incidence rate ratio of 2.64 (95% confidence interval, 2.39 to 2.88) relative to the female incidence rate. It was found that 71.8% of the dislocations were in males (73).

The overall incidence shoulder dislocation rate was 56.3 [95% confidence interval (CI) 50.2– 62.4] per 100 000 person-years, with rates of 82.2 (95% CI 71.7–92.8) and 30.9 (95% CI 24.5–37.3) in men and women, respectively. The incidence of primary dislocations was 26.2 (95% CI 22.1–30.4) (95).

The results indicate that different shoulder injuries show different prevalence between men and women depending on the type of injury. In general, shoulder injuries were more common in men than women in exercise and shoulder dislocations, and were more common in women than men in excessive repetition of injuries.

Related fall in sports

Enger *et al.* showed that a fall was reported as the cause of injury in 70%, with the highest percentages at each end of the age range. The rest were mainly caused by a collision with a person or an object (17%) or by acute overload (10%), both of the latter mainly in young adults (25).

An increased risk of home/leisure injuries in males up to eighteen has previously been reported in a Scottish study of adolescents (96). A study of adults over 65 years old visiting US emergency departments with fall related injuries, found a rate ratio of 2.0 for arm/hand injuries in women compared to men (97), corresponding to our findings in the age group above 75 years. The observed dominance of young males in the population suffering a glenohumeral or acromioclavicular joint dislocation is according to previous studies (73, 74, 95,97).

A 74-year-old woman was brought to the ski clinic shortly after a fall on her left shoulder while skiing (98). A dimple or flattening of the anterior shoulder, posterior prominence of the

shoulder, limited external rotation and holding the arm in a 'sling' position are common physical findings in posterior glenohumeral (GH) dislocations(99).Patients with ACJ sprain, distal clavicle fractures and proximal humerus fractures often present with deformity in the related anatomic locations with significant local tenderness. In these cases, shoulder range of motion is usually limited secondary to pain with no mechanical limitation. Typically in these missed cases, an axillary view is not obtained because of patient discomfort. A missed posterior dislocation can result in severe pain, neurovascular compromise and increased injury severity that can result in the need for more complex and complicated shoulder reconstructions and ultimately result in permanent shoulder dysfunction(100).
The results indicate that shoulder injuries due to falls in sport are more common in the elderly.

Conclussion

Most sports injuries involve the upper limbs. Sports injuries are injuries that occur during sport, athletic activities, or exercising.The shoulder has a high range of motion in the body thus it is more prone to injury. Shoulder structures that are affected by injury vary substantially with age and gender.

Examining the incidence of this injury in different sports shows that the incidence of shoulder injury is higher in what conditions it can be prevented.

Comparison of the incidence of shoulder injuries in athletes shows that the increased risk of shoulder injuries in young men is mainly related to sports injuries. Men are more prone to upper limb injuries. It is seen more in professional sports than amateur and in contact sports more than non-contact sports.

Limitations:

There were limitations to this systematic review. First, the lack of access to all databases in which articles has been published. Second, the stated complication rate, given extracted from retrospective data, is likely an underestimation of the true complication rate because the authors of the analyzed studies may not have reported minor complications despite their occurrence in different sections. Third, although the mean age was younger, the range was quite large. The shoulder injuries characteristics in these very different age groups introduce significant cofounders into drawing significant conclusions on the relationship between age and complications. However, although some studies contained high levels of evidence, most limited the retrospective to a single case study. The present study is the result of a search and review in reputable databases and is one of the few articles that separate age, sex, contact and non-contact sports, at the professional and amateur level and examine shoulder injuries in sports and non-sports.

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