Review

Epidemiology of High Ankle Sprains

A Systematic Review

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Abstract: *Syndesmotic sprains or high ankle sprains are reported to be associated with increasing morbidity and time loss. The aim of this study was to critically appraise literature on epidemiology of syndesmotic sprains through systematic review of published literatures. A systematic review was conducted online for literature published in English using PubMed and Google Scholar, as per PRISMA guidelines up to April 30, 2019. Predefined eligibility criteria were applied, and the data thus compiled were analyzed. A total of 26 studies were found to be eligible, of which three-fourths involved sporting population. Considerable inconsistency in assessment procedure reporting, injury and injury severity definition with variable unit measures used to describe incidence or injury rate was observed. Meta-analysis and intra- and intersports comparison could not be performed owing to the study heterogeneity and methodological variability. There is a need for standardization in future research, specifically with regard to injury assessment and reporting, demanding heightened awareness and improved diagnostic modalities, as injury epidemiology is integral to the overall injury-prevention conundrum.*

Levels of Evidence: *Systematic review, Level III*

Keywords: high ankle sprain; syndesmotic sprain; epidemiology; incidence; frequency

Ankle sprains, the most common type of ankle injury in sports,[1] have been shown to exhibit age-, gender-, and sport-specific differences.[1-3] Additionally, ankle sprains has been associated with increased morbidity,[4] increased recurrence,[4] and increased health care expenditure.[3,5,6]

Lateral ankle sprains are reported to be the most common type of ankle sprain, followed by syndesmotic sprains.[2] But then, syndesmotic sprains, in contrast to lateral ankle sprains, are associated with increased morbidity.[7-10]

Studies focussing on syndesmotic sprains are limited with its diagnosis and management being topic of huge debate.[1,11] The true incidence of syndesmotic sprains is not well established, with few considering it underreported.[12] Consequently, the knowledge and awareness about syndesmotic sprain epidemiology will aid in improving diagnostic and therapeutic approach, and laying preventive strategies, thereby reducing the disease burden and severity.

> ". . . the knowledge and awareness about syndesmotic sprain epidemiology will aid in improving diagnostic and therapeutic approach . . ."

Thus, the primary purpose of this systematic review was to explore and summarize the incidence and prevalence of syndesmotic sprains, and secondarily to explore the injury severity and to determine if there are any age-, gender-, or sport-specific variations in injury trend. Additionally it was purported if possible to perform meta-analysis from the existing data.

Methodology

Computerized literature searches, in accordance with the Preferred Reporting Items for Systematic Reviews and

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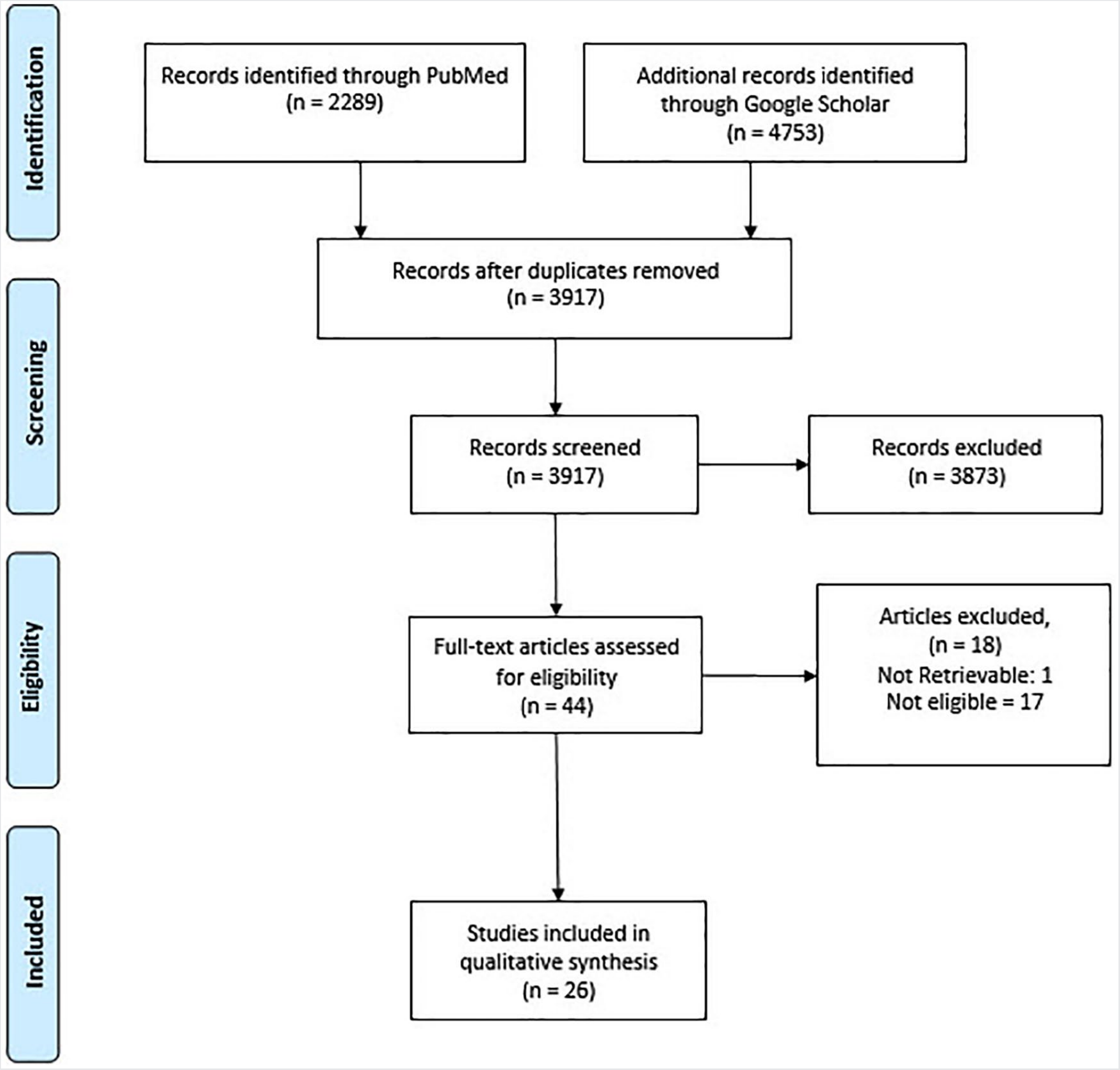
Figure 1.

Study selection flowchart.



Meta-Analyses (PRISMA) guidelines (Figure 1),[13] were performed for articles published in English using PubMed and Google Scholar, from inception through April 2019. The keywords used were "syndesmosis," "syndesmotic," "tibiofibular," "ankle sprain," "ankle injuries," and "high ankle" in combination with "epidemiology," "incidence," "prevalence," "severity," or "risk" across databases. The bibliographies of all located articles were also searched. All published review were included. The search was conducted between August 1, 2018, and April 30, 2019. Ethical approval was not obtained as the study essentially was a review of previously published works.

Though high ankle sprains (HAS) most commonly involve anterior inferior tibiofibular ligament,[14,15] for the purpose of this review HAS or syndesmotic sprains were defined as those involving any ligaments of distal tibiofibular joint, namely the anterior inferior tibiofibular ligament, posterior inferior tibiofibular ligament, the interosseous ligament, and the interosseous membrane.[16-18]

Study Validity

Screening of all eligible publications was carried out by a single reviewer, for titles, abstracts, full text, and bibliographies.

Inclusion Criteria

Studies were considered eligible if they fulfilled the following criteria:

- Original epidemiological studies published in English, irrespective of study design (randomized,

cross-sectional, cohort—prospective or retrospective),
- Studies clearly defining injuries
- Studies reporting syndesmotic sprain frequency, incidence and/or prevalence specifically
- Studies focussing on injuries in any age group, any gender, or amid any occupational group (sports, recreational, patients, military)

Exclusion Criteria

Studies were excluded if they adhered to any of the following exclusion criteria:

- Article published in languages other than English
- Systematic reviews, narrative reviews, case reports, expert opinions, commentaries, letters, and anecdotal accounts
- Studies reporting syndesmotic injuries in association with distal ankle fracture
- Studies lacking full text
- Studies reporting on injuries other than syndesmotic sprains
- Studies reporting ankle injuries but not mentioning syndesmotic sprains
- Duplicate publications

Outcomes

The primary outcomes of interest were syndesmotic sprain injury rates, with secondary focus on the demographic variables (age, gender), body mass index (BMI), injury profile (mechanism, severity, reinjury, associated injury), and sporting profile (different sports, playing surface, playing time, playing position, opportunities missed).

Data Extraction

Data were extracted independently by a single reviewer from the reports and included study characteristics (author and year of publication), sample characteristics (study population, age, gender and study setting), study design, source of information, injury definition, sports, injury assessment tool, assessor details, syndesmotic sprain injury rate, and severity of injury. Data were summarized using descriptive statistics. In case of any missing data, no attempt was made to contact the corresponding author.

Data Analysis

Data were summarized using descriptive statistics (Tables 1-6), with means and standard deviations for continuous variables and frequencies and percentages for categorical variables.

Results

A total of 27 articles were identified, of which 26 articles[12,19-43] were included in the current review, as 1 study was not retrievable.[44] The study population varied grossly across studies with 73% of the studies involved sporting population,[20,21,24,25,27-29,31-36,38-43] 15% involved military population[12,19,22,30] and the remaining 12% involved general or patient population.[23,26,37] The data on age and gender were incompletely reported, with only 35% of the studies reporting on age that ranged from 4 years to 85 years.[12,19,22,23,25,26,35-37] Of those studies reporting gender, 31% were done exclusively on males,[19,25,29,32,34,36,40,42] 4% was done exclusively on females,[21] while 35% involved both.[23,24,26,30,33,35,37,41,43]

Of the studies included in the review, 54% of the studies were prospective in nature,[12,21-25,29,30,33,34,36,40,41] and 46% were retrospective.[19,20,26,27,31,32,35,37-39,42,43] Half of the studies included in the review have been published within past 5 years.[31-43]

In two-third of the studies, a proper injury definition was not provided, and in about one-third of the studies, the mode of diagnosis was not described clearly. The narrative summary of the studies included in this review, the distribution of HAS, and return to play postinjury are summarized in Tables 1 to 6.

Meta-analysis and intra- and intersports comparison could not be performed owing to the study heterogeneity and methodological variability in terms of participant characteristics, injury definition, injury assessment, and varied unit of measures used. Hence a narrative approach was used in the current review.

Demographic Variables

- *Age*: The results were not conclusive, with 2 studies reporting increasing age to be associated with increased risk of HAS,[24,37] with majority of injuries occurring in those aged between 18 and 34 years,[24,35] while one study reported age not to be a predictor of injury.[36] The injury rate per 100 000 person-year (PY) was reported to be 3, 2.5, 2, and 1.6 in those aged between 18 and 34 years, 35 and 49 years, 50 and 64 years, and ≥65 years, respectively.[37] Further injuries were also reported to be twice more common in intercollegiate events as compared with interscholastic ones.[24]
- *Gender (Table 5)*: Studies reporting gender-based injury distribution were limited and were not conclusive, with 2 studies reporting injuries to be greater in males compared with females,[37,41] and 3 reporting no gender difference.[24,30,43] Furthermore, based on level of participation, injuries were reported to be higher in females at scholastic levels, with no gender difference at collegiate level.[24] Similarly, based on grade of injury, grade I sprain were reported to be more common in females, while grade II and III sprains showed no gender difference.[24]
- *Body mass index*: Results were equivocal, with 1 study reporting individuals with HAS to be of significantly higher BMI than those with no injury,[30] while another study found BMI not to be a predictor of injury.[36]

Injury Profile

- *Injury definition*: Injury definition varied considerably across studies (Table 2). Furthermore, only 2 studies defined the ligaments that constitute syndesmotic sprain or HAS,[36,40] as those involving any ligaments of distal tibiofibular joint, namely the anterior inferior tibiofibular ligament, posterior inferior tibiofibular ligament, the interosseous ligament, and the interosseous membrane.

Table 1.

Narrative Summary of the Included Studies.

Study (Reference No.)	Year	Study Population	Data Source	Study Design	Assessor/Setting	Study Period	Sample Size (n)
Military based							
12	1998	US Military Academy cadets	P/E and radiographs	Prospective	Orthopaedic surgeon	2 months	N/R
19	1990	US Military Academy cadets	Clinical records	Retrospective	N/R	41 months	N/R
22	1998	US Army Airborne School Students	Clinics, hospital, and ED records	Randomized	Orthopaedic surgeon	1 week	745
30	2011	US Military Academy cadets	Cadet Illness and Injury Tracking System	Prospective	Orthopaedic surgeon, physician assistant, trainer	4 years	N/R
Population/patient based							
23	1998	Patients	P/E and imaging	Prospective	ED and occupational medicine clinic	33 months	639
26	2004	Patients	MRI	Retrospective	2 MSK radiologist	N/R	94
37	2014	Population based	ICD-9 codes	Retrospective	ED and inpatient	1 year	N/R
Sports based							
20	1991	Football (Professional)	Training room record (P/E)	Retrospective	Trainer, team physician	6 years	N/R
21	1993	Gymnasts (Women's Intercollegiate)	N/R	Prospective	Trainer, team physician	53 seasons (4 years)	26
24	2000	Basketball (Scholastic and Intercollegiate)	Clinical examination	Prospective	Trainer, team physician	2 years	11 780 (95 institutions)[a]
25	2000	National Basketball Association	Injury Surveillance System	Prospective	Trainer, team physician	10 years	1094 (29 teams)
27	2004	National Hockey League	Medical records	Retrospective	Trainer	10 years	N/R
28	2005	NCAA Ice hockey teams	Injury reporting system	Prospective	Trainer	1 season	8 teams

(continued)

Table 1. (continued)

Study (Reference No.)	Year	Study Population	Data Source	Study Design	Assessor/Setting	Study Period	Sample Size (n)
29	2008	Rugby (Professional)	P/E and imaging	Prospective	Physician, physiotherapist	2 seasons	546 (12 Rugby Unions)
31	2013	Football (NCAA)	Injury Surveillance System	Retrospective	Team physician, trainer	5 seasons	N/R
32	2013	National Football League	Team database	Retrospective	Trainer, orthopaedic team physician	15 years	N/R
33	2013	US high school athletes (20 sports)	Internet-based surveillance system	Prospective	Trainer	5 years	5373
34	2013	Football (UEFA Champions league)	Onsite, injury cards, OSICS 2.0	Prospective	Coaching staff and club medical officer	11 years	1743 (27 European clubs)
35	2014	Athletes (National Sports Medicine Program)	MRI	Retrospective	MSK radiologist	4 years	261
36	2014	Rugby Union and League	Onsite recording	Prospective	N/R	2 seasons	202
38	2015	American Football	NCAA—ISS	Retrospective	Trainer	5 seasons	N/R
39	2017	Football (youth, high school, college)	Injury Surveillance Programs (3)[b]	Retrospective	Trainer	3 years	Teams[c]
40	2017	Football (UEFA Elite Club)	Injury Cards, OSICS 2.0	Prospective	Team medical staff	15 seasons	3677 (61 teams])
41	2017	NCAA (25 Sports)	Injury Surveillance System	Prospective	Trainer	5 years	N/R
42	2018	National Football League combine	Players chart, P/E	Retrospective	Orthopaedic surgeon	7 years	2285
43	2018	Collegiate Basketball	NCAA—ISP/ISS	Retrospective	Trainer, team physician	10 years	222 teams[d]

Abbreviations: P/E, physical examination; N/R, not reported; ED, emergency department; ICD, International Classification of Diseases; MRI, magnetic resonance imaging; MSK, musculoskeletal; NCAA, National Collegiate Athletic Association; ISP/ISS, Injury Surveillance Program/System; UEFA, Union of European Football Associations; OSICS, Orchard Sports Injury Classification System.

[a]95 institutions included 14 colleges/universities and 81 high schools.

[b]Youth Football Safety Study (YFSS); the National Athletic Treatment, Injury and Outcomes Network (NATION); and (3) NCAA- ISP.

[c]Included 13 youth football leagues, 96 secondary school football programs, and 34 member institutions.

[d]222 teams included 109 men's and 113 women's teams.

Table 2.

Injury, Injury Severity, and Various Other Definitions Used Across Studies.

Injury:

- Reportable injury requiring medical attention from athletic trainer or medical personnel or both[19,21,22,24,25,27,31,33,38,39,41,43]
- Injury leading to participation restriction for one day or in the immediate training, game, or work[19,21,22,25,28,29,31,33,34,38,43]
- Injury that occurred in an organized practice or competition[33,38,39,43] or performance (cheerleading)[33]
- Injury requiring emergency care[25]

Injury incidence/rate:

- Injury incidence was defined as the number of injuries per 1000 player-hours[34,36,40], or per 1000 person-years[30], or per 1 00 000 person-years,[37] or per 1000 athlete exposures,[31,39,43] or per 10 000 athletic exposures,[33,38,41] or per 1000 jumps[22]

Injury burden:

- Injury burden was defined as number of days absence per 1000 player-hours[34,40]

Injury diagnosis:

- Injury with confirmed issue damage[21]
- Injury defined based on ICD-9 codes for syndesmotic injury,[37] injury codes,[38] Orchard Sports Injury Classification System[34,40]
- Injury diagnosed based on physical examination[12,19,20,22-24,27,29,30,32,40,42]
- Injury defined using imaging[12,19,21-23,26,29,30,32,35,40,42]
- Injury reported using Injury Surveillance System or Injury Reporting System[25,28,31,33,34,39,41,43]

Injury severity:

- Time loss injury: Participation restriction of 24 hours or more[30,38,39,41] with participation restriction of more than 21 days or premature end of season classifying as severe injuries[29,30,39,41] or more than 28 days,[34,40] or time between the date of original injury and return to a level of play that would allow competition participation[43] or player being unable to take a full part in future football training or match play[40]
- Injury classification system or grading: West Point Ankle Grading System[12,30,32]; modified Orchard Sports Injury Classification System[29,34,40]; modified grading system[22]; Jackson's classification system[19]
- Return to play: Return to restricted to unrestricted participation, and symptom resolution[21,29]
- Missed opportunities: Number of missed or limited practices, and number of missed games[20,28,31]
- Need for surgical interventions[31,39] or percentage of injuries requiring surgery[38]
- Need for imaging or surgery for diagnosis[29]
- Season or career ending medical disqualifications[38,39]

Reinjury or recurrence:

- Injury of the same type and at the same site as an index injury[34,40] or injuries that recurred from the same or previous academic years[43]

- *Injury rate/incidence/frequency*: 35% of studies reported injury incidence or rate in varied measures[22,30,31,34,36,37,39, -41] (Tables 2-4) leading to incomparability. Similarly, HAS was reported with varying frequencies across studies (Table 4).[12,19-23,25,26,29-31,33-35,38-40,42]
- *Injury mechanism*: Of the studies reporting injury mechanism, player contact accounted for the most number of injuries ranging from 46.3% to 75.2%[29,31,32,40,41,43] in sports. While other studies reported the mechanism to vary considerably[19] or difficult to ascertain.[20,27] Injury due to contact in sports was reported to be the most common mechanism irrespective of gender[43] or level of participation.[39] Furthermore, number of contact injuries were shown to increase with level of sports participation from youth to college level.[39]
- *Injury severity*: Injury severity were reported inconsistently across studies using variable parameters (Tables 2 and 6). The average time loss due to HAS ranged from 14 to 55 days (Table 6).

Based on severe injury definition of time loss from sport of more than 21 days, severe HAS ranged from 15.8% to 58%,[20,29,30,41] while with definition of 28 days or more it ranged from 57% to 67%.[34,40]

Proportion of HAS resulting in time loss of 7 days or more were found to be higher in males in 1 study,[41] while it was reported to be higher in females in another study.[43] Though no difference in injury severity was reported based on gender in sex-comparable sports,[41] some observations were reported based on certain gender-specific sports with men in sports like lacrosse and ice hockey reporting more of severe HAS injury (time loss of 21days or more), and

Table 3.

Summary of High Ankle Sprain Injury Rate Across Studies.

Study (Reference No.)	High Ankle Sprain Injury Rate	
30	per 1000 person-years	4.8
37	per 100000 person-years	2.09
31	per 1000 athlete exposures	0.24
41		1
39		0.03 (youth)
		0.15 (high school)
		0.29 (college)
40	per 1000 player-hours	0.05
36		0.59
34		0.036
22	per 1000 jumps	1.09

Table 4.

Summary of Percentage Distribution of High Ankle Sprain Across Studies.

Study (Reference No.)	Percentage of Ankle Injuries	Percentage of Ankle Sprains
12	15.4	16.7
19	—	1.1
20	18.4	—
21	5.6	14.3
22	—	27
23	5.7	—
25	0.7	0.8
26	63	—
29	8.4	—
30	—	6.7
31	—	24.6
33	—	22.2
34	3.5	5.2
35	20.3	—
38	22.7	—
39	—	4.8 (youth)
		20.3 (high school)
		24.4 (college)
40	4.8	7
42	28.9	33.6

women in sports like lacrosse and basketball reporting only less than a week of time loss injuries.[41]

Only 2.7% to 4% of HAS were reported to be severe based on the injuries requiring surgery,[29,31,38,39] while 8.4% were found to be severe based on season or career ending medical disqualifications.[38]

Severe injuries were further reported to be occurring with increasing frequencies based on level of participation irrespective of time loss or injury requiring surgery criteria.[39]

In addition, study by Sankey et al[29] also reported that new injuries (83%) were more severe in nature as compared to recurrent injuries (17%). In the same study,[29] injury severity was also found to vary with mode of diagnosis, with injuries diagnosed surgically or radiologically (58%) reported to be of severe nature (time loss of more than 21 days) in comparison to those diagnosed clinically (42%).

Injury were graded according to West Point Ankle Grading System in 2 studies,[12,32] who reported 44.44%[32] and 56.25%[12] grade I injuries, 55.56%[32] and 37.5%[12] grade II injuries, and 6.25%[12] grade III injuries. Interestingly, grade I injuries were reported to be associated with poor outcome and grade III injuries, in addition, to be associated with prolonged disability.[12]

Furthermore, on following HAS injuries on long term, 38% were associated with functional disability[12] while 75% to 90% were associated with calcification.[19,20]

- *Reinjury*: Reinjury rates were reported in 39% of the studies, that too exclusively in sporting population, with reinjury rates ranging from 0% to 17%.[20,27,29,32,34,39-41,43] Though higher recurrence was reported in women's ice hockey and men's lacrosse,[41] no difference in recurrence rate was reported in sex-comparable sports.[41] Increasing percentage of reinjuries were reported based on level of participation (6.4% in collegiate, 4.4% in high school, and 0% in youth).[39]
- *Associated injuries*: HAS are reported to be increasingly associated with tibial osseous involvement and talar

Table 5.

Gender Distribution of High Ankle Sprain Across Studies.

Study (Reference No.)	High Ankle Sprain Injury Rate	
	Males	Females
30	4.9 per 1000 person-years[NS]	4.6 per 1000 person-years[NS]
37	2.15 per 1 00 000 person-years[S]	1.65 per 1 00 000 person-years[S]
41[a]	0.64 per 10 000 athlete exposures	0.36 per 10 000 athlete exposures

Abbreviations: NS, not significant; S, significant.
[a]Based on sports data in which both males and females participated;

Table 6.

Injury Severity: Mean Return to Play/Work Time (Days).

Study (Reference No.)	Mean Return to Play/Work Time (Days)
19	55
27	45
29	20
30	
Overall	13.9
Male	13.4
Female	18.3
32	15.4
34	43
40	39

bone contusions.[26,35] Acute injuries were reported to be significantly associated with bone bruises (78.3%), chronic injuries were found to be significantly associated with joint incongruency (58.3%), while both acute and chronic injuries were significantly associated with talar dome osteochondral defect and higher tibiofibular recess measure.[26] Though both acute and chronic injuries were reported to be associated with osteoarthritis, this association was not statistically significant.[26] In addition, HAS has been reported to be associated with lateral ankle sprain in 13% to 83%.[26,33,35,42]

Sporting Population

Of the varied sporting disciplines studied, American football[20,31-33,38,39,41,42], basketball[24,25,33,41,43] and soccer[33-35,40,41] were the most studied sports.

Injuries were reported to be more common during competition than practice[27-29,31,32,34,40,41] with 56.7% to 86% of injuries occurring during competition.[27,29,32,40,41] Injuries were 13 to 14 times more likely to occur during competition than practice,[31,40] with injury rate of 1.63 per 1000 athlete exposure (AE)[31] or 0.148 per 1000 player-hours[34] during competition as compared with 0.09 per 1000 AE[31] or 0.015 per 1000 player-hours[34] during training.

In-depth analysis in 1 study showed injuries during competition to be more common in regular season (0.28 per 1000 AE) than pre- (0.18 per 1000 AE) or postseason (0.15 per 1000 AE), and injuries during practice were more common during preseason (0.18 per 1000 AE) than regular (0.09 per 1000AE) or postseason (0.06 per 1000 AE).[31] The study also reported no significant difference in injury rate between home and away matches.[31]

- *Injury burden/missed opportunities*: The number of games missed due to HAS ranged from 0 to 18, while the number of practice sessions missed ranged from 2 to 21.[20,28,31] However, 1 study reported this to be of no statistical significance.[31] Injury burden was reported to be 1.8 days of absence per 1000-hour exposure.[40]
- *Playing position*: The injury rates were reported across 3 sports (American football, National Hockey League [NHL], and rugby) in relation to playing position.[20,27,29,31,32,42] In football, wide variability was reported across studies with regard to the injury rates based on player position. While Boytim and colleagues[20] reported no relation of injury to player position, other studies found running backs (15.5%)[31] or offensive linemen (19.2%)[42] or line backers (28%)[32] to sustain higher injury rates. On the other hand, in the sport of NHL, injury was commonly reported among forwards (71.4%).[27] In rugby, 1 study reported the injury to be common in outside backs,[29] while other reported it not to be a predictor of injury.[36]

- *Playing surface and condition*: The findings with regard to HAS occurrence in association with playing surface and condition was found to be contrasting with one study reporting no effect of playing surface on HAS,[20] and the others reporting increase in injuries based on playing surface and condition.[29,31,32] HAS was reported to be significantly more common while playing on third-generation surfaces (0.29 per 1000 AEs) in contrast to on natural grass (0.22 per 1000 AE), but there was no significant association when injuries that occurred on natural grass was compared with first- or second-generation playing surfaces (0.25 per 1000 AE).[31] Similarly, Osbahr and colleagues[32] reported injuries to be higher when played on grass (50%) than on field turf (25%) or astro turf (17%). Sixty percent of injuries were reported to occur on slippery heavy surface and 40% on firm-hard surface in 1 study,[29] while another reported injuries to be more common in normal field conditions (75%) than wet (11%) or hard (6%) conditions.[32]
- *Participation level*: Injuries were reported to occur at double the rate during intercollegiate events than intramural or interscholastic participation.[24,30,39] Reinjuries were more common in collegiate level (6.4%) than high school (4.4%) or youth level (nil) participation.[39] Similar picture was seen with severe injury occurrence being more common and with increasing rate (per 1000 AEs) at college level than at high school or youth level participation[39] irrespective of the definition criteria of injuries requiring surgery or time loss of more than 21 days being applied.
- *Time of play*: Only 2 studies reported injury in association with time of play in rugby[29] and football.[32] In rugby, 75% of injuries that occurred were recorded during second half of the game (between 41 and 80 minutes),[29] similarly in American Football, most of the injuries were recorded during fourth quarter (31%).[32]

Miscellaneous Variables

Though 54% of injuries were recorded in dominant leg,[40] 78% of injuries were recorded in ankles that were taped,[32] and 3% injuries were recorded in ankles with brace,[32] no associations were reported between laterality[31,36] or footwear[20,36] or braces and HAS[22] in other studies.

Discussion

This study is a systematic review to explore the epidemiology of ankle syndesmotic sprains or HAS from various studies published in English through inception till date (2019). Almost half of the studies included in the present review were largely published over the past 5 years demonstrating the growing interest and awareness of this injury type. Majority of the studies were done on sporting population. The result from this review showed a sizable variation in syndesmotic sprain injury frequency and incidence estimates, with variable unit measures being used to report the same across the studies.

There was dearth in studies reporting injuries in different age groups. Of those accounting for the age, second to third decade of life was found to be prone to increase injury risk. The present review revealed conflicting evidence with regard to gender, with few studies reporting males to be at higher risk while others finding no gender difference. This may be of significance as gender-based differences in intrinsic risk factors and exposures have been reported.[11,33,45] HAS was often reported to be severe in nature associated with morbidity[26,33,35,42] and recurrence.[20,27,29,32,34,39-41,43]

It was no surprise, that about three-fourth of the studies were carried out in sporting population, as ankle sprains has been reported to be a most common sporting injury[1] due to the complex and repetitive movements, and heavy demands across sports.[1,21,31] In sports, injury risk was highest during competition[27-29,31,32,34,40,41] and was shown to result in missed opportunities.[20,28,31,40] Possibility of control over training environment as compared with competition[31] coupled with greater intensity of game play during competition[39] may explain the Injuries being more during competition than training or practice. Contact was the most common form of injury mechanism reported in sports. Furthermore, injury correlation with player experience, level of participation, time of play, and playing surface was not possible due to insufficient data.

The varied injury rates and estimates may be partly explained to be due to the varied data collection methods and diagnostic approaches used across studies. Few studies used various records (training and clinical) and injury surveillance system, while others used clinical, radiological or both as assessment tool (Table 1). Thus, it was not possible to derive the total incidence of HAS in the current review. Furthermore, lack of a standard exposure time measure rendered comparing data futile. The various injury rate measure used in the present review like AE and PY has been reported to lack sensitivity as it does not account for the actual time (minutes or hours) the player was in play.[25,46] More so owing to the varied game duration across sports with play time being of 80 minutes in rugby, 60 minutes in American football and 48 minutes in high school football.

The other 2 study populations involving military population and hospital-based population, also exhibited sizable variability in injury rates (Tables 3 and 4). This might be due to the fact that the military population were exposed to various high-intensity training program in addition to sports, while the hospital-based population included those patient who had severe injuries necessitating further investigations like magnetic resonance imaging (MRI) or requiring surgical intervention.

Injury severity also varied grossly across studies, as different definitions were utilized to classify severity ranging from time loss injury,[21,29-31,38,39,41] need for surgery,[29,31,38] to different injury grading and classification systems.[12,19,22,29,30,32] This creates a need for uniform injury severity classification system.

Furthermore, other factors also needs to be considered while reporting injury severity like diagnostic mode, treatment approach, injury to competition time gap, and nature of competition.[21,40] This is of significance as HAS has been reported to be almost 3 to 4 times severe than lateral ankle sprain[19,20,27,34,41] and medial ankle sprain.[34,41]

Injury recurrence rate was reported in limited number of studies[20,27,29,32,34,39-41,43] exhibiting wide variability. This may be partly attributed to the consideration of a recurrent injury as acute injuries that occur on different occasions[47] and partly due to the conservative estimation of the injury due to different assessors.[41] Furthermore, there was lack of data on previous syndesmotic sprain, though 1 study from Australia reported it not to be a predictor of injury.[36] This might be of significance as previous history of ankle sprain is known to be a strong predictor of further ankle sprains.[46,48,49]

The study is not without limitations, and hence demanding caution in interpreting the data. Studies published in non-English languages were not included. Furthermore, the varied study design with 46% being retrospective, heterogeneous study sample and characteristics, variable injury definition, variable assessors involved ranging from trainer to multiple health care personnel with lack of data on their experience level, lack of data on injury chronicity, selection bias, and different data collection methods add to the study limitation.[32,40,42] The studies included are also confounded by varying level of access to medical care,[38,39,42,50] being MRI based,[26,35] or being emergency department based.[23,37] This is of significance as those with severe injuries would be the ones opting for or requiring MRI or medical care, thereby leading to underreporting of minor injuries. Finally, the study was based on a single reviewer.

The result of this study, although cannot be generalized, can serve to create an increased awareness among athletic trainers and health care professionals about syndesmotic sprain and its severity, thereby improving diagnostic awareness, ensuring appropriate treatment, and hence enhancing faster and better return to play.

Conclusion

This systematic review attempts at summarizing the available epidemiological information giving an insight in to the magnitude of the problem. Though there has been a growing interest in HAS epidemiology over the past 5 years, the reporting needs to be standardized. The data on the incidence of syndesmotic injury are limited, and most of them come from sports. Owing to the heterogeneity in study population, study methodology, injury assessment, and reporting, the evidence from the current review is grossly limited lacking generalizability. But then from the heterogeneous data, it may tentatively be concluded that high ankle sprains are not an uncommon ankle injury as once considered, especially in sporting population. There is a need for standardization in future research, specifically with injury assessment and reporting, demanding heightened awareness and improved diagnostic modalities, as injury epidemiology is integral to the overall injury prevention conundrum.

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