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REVIEW ARTICLE

Injuries among volleyball players: a comprehensive survey of the literature

Filippo Migliorini[1] · Björn Rath[1] · Markus Tingart[1] · Marc Niewiera[2] · Giorgia Colarossi[3] · Alice Baroncini[4] · Jörg Eschweiler[1]

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Abstract

Aim The purpose of this systematic review is to analyse and summarize current literature, to obtain an extensive overview, and improve the evidences concerning injury patterns in volleyball players.

Materials and methods A comprehensive review of the literature was conducted. The main databases were accessed: PubMed, Medline, CINAHL, Cochrane, Embase and Google Scholar. Articles in English, French, Spanish, Italian, and German were considered for inclusion. We focused on the following outcomes of interest: injury place, type of injury, circumstance, injury severity. Missing data pertinent to these parameters warranted exclusion from this systematic review. We referred to the Newcastle–Ottawa Scale for the methodological quality assessment.

Results A total of 28,889 patients were enrolled. The mean age was 22 years and the mean follow-up 24.9 months. There were seven retrospective cohort studies and 16 prospective cohort studies. The mean injury rate was 4.21/1000 playing hours. The methodological quality assessment resulted moderate. The lower limb was the most affected area, followed by the upper limb, trunk, and the head. Regarding lower limb, the most commonly injured area was the ankle, followed by the knee. Joint injuries were the most frequent, mostly represented by sprains and ligament damages. Spiking and blocking represented the most frequent circumstances correlated with these injuries. Acute onset lesions were more frequent than those caused by overuse. About a third of the injuries entailed a short-term absence from the field.

Conclusion Though volleyball is commonly considered to be a safe sport, the overall probability of sustaining an injury is comparable with previous reports from other high-contact team sports.

Keywords Volleyball · Injuries · Net zone · Trauma · Ankle sprain · Jumper's knee · Spiking · Blocking

Introduction

Volleyball is one of the most practiced sport worldwide. Though volleyball is considered to be a safe sport [1], it is nevertheless characterized by a high probability of sustaining a variety of injuries [2]. Up to date, many risk factors that can predispose to injury have been described: body height, age, league, court position, warm-up, previous injuries [3–5]. Over the past decades, several retrospective or prospective cohort studies attempted to characterize injury patterns [5–10]. However, related results are dispersive and ambiguous. In addition, most of the review treating volleyball injuries aimed at specific areas of the body or specific subjects [11–13]. Currently, there is a lack of a detailed literature review that shows a quantitative and comprehensive representation of injury pattern in volleyball. Therefore, the purpose of this systematic review is to analyse and summarize current literature, obtaining further information and improving the evidence concerning injury patterns among volleyball players. To achieve the purpose, we focused on the type and severity of injuries and the most at-risk areas of the body, circumstances, place of the court, contact between players and the onset of the traumas. We believe

✉ Filippo Migliorini
migliorini.md@gmail.com

[1] Department of Orthopaedics, RWTH Aachen University Clinic, Pauwelsstraße 30, 52074 Aachen, Germany

[2] Department of General Surgery, Eifelklinik St. Brigida, Simmerath, Germany

[3] Department of Cardiosurgery, RWTH Aachen University Clinic, Aachen, Germany

[4] Department of Orthopaedic Surgery, Eifelklinik St. Brigida, Simmerath, Germany

that a comprehensive overview of traumas and related injury mechanisms can optimize the prevention and rehabilitation programs.

Materials and methods

Literature search

Two reviewers (FM, JE) conducted the search separately. To guide the search, we compiled a preliminary protocol determine the eligibility criteria. The present systematic review of the literature was performed according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) [14]. In December of 2018, the following databases were accessed: PubMed, Medline, CINAHL, Cochrane, Embase and Google Scholar. The following keywords were used in combination: volleyball, injuries, pain, net zone, trauma, ankle sprain, jumper's knee, spiking, blocking. The time frame for the search results ranged from 1990 to 2018. Articles in English, French, Spanish, Italian and German were considered for this work. According to the Oxford Centre of evidence-based medicine [15], level I–IV articles were included. We excluded from the present investigation editorials, comments, expert opinions, meta-analyses, and reviews. To identify further articles of interest, the bibliography of the included studies was screened as well. Only articles focusing on volleyball injuries presenting quantitative data under the outcomes of interest were included. Missing data pertinent to these parameters warranted exclusion from this systematic review.

Data extraction and quality assessment

Data extraction was performed by two independent authors (FM, JE). The level of evidence was assigned to each study using the published guidelines [15]. The following data were extracted:

- generalities: author, year, league of the samples, number of the samples, mean age (years), follow-up (months), injury rate/1000 h;
- injury place: head, (face, head, neck, cervical spine), trunk (sternum, ribs, upper back, lower back, sacrum, pelvis, abdomen), upper limb (shoulder, clavicula, upper arm, elbow, forearm, wrist, hand, finger), lower limb (hip, groin, thigh, knee, lower leg, achilles tendon, ankle, foot, toe);
- type of injuries: joint injuries (cartilage injuries, ligament injuries, tendon injuries, meniscus injuries, sprains, dislocations), bone injuries (contusions, concussions, fractures), muscle injuries (muscle damage, strain), cuts, lacerations, wounds, hematomas;
- circumstance: reference to play event (spiking, blocking, setting, landing), place of the court (net zone vs back row), contact (non-contact vs contact), onset (acute vs overuse);
- injury severity (assessed in terms of absence from competitions or trainings): minor (< 7 days), moderate (8–28 days), major (> 28 days).

Methodological quality assessment

For the methodological quality assessment, we referred to the Newcastle–Ottawa Scale (The Ottawa Hospital Research Institute, Ottawa, ON). Two independent assessors (FM, JE) performed the quality assessment. This score evaluated the included studies under several criteria: Representativeness of the exposed and non-exposed cohorts, comparability, outcome assessments, evaluation of the follow-up. The final result ranks from 0 to 10 points. Values > 6 points are considered acceptable.

Statistical analysis

Data under the same outcome were analysed referring to the weighted mean, arithmetic sum, percentage and standard deviation. For dichotomous comparisons, we referred to the Student T test. A $P < 0.05$ was considered statistically significant.

Results

Search results

The literature search resulted in 714 articles. 70 duplicates were removed. Another 568 articles were excluded for not matching the eligibility criteria. This left 79 potentially eligible articles. We further excluded 59 articles due to a lack of quantitative data under the outcomes of interest. This left suitable 23 publications for this systematic review. The literature search is shown in Fig. 1.

Methodological quality assessment

The Newcastle–Ottawa Scale (NOS) score resulted in 6.13 points, attesting to the methodological quality assessment of the present work a moderate value. The points of strengths of the present work are represented by the considerable amount of examined samples and the extensive follow-up terms of most of the studies. Limitations are represented mostly by the overall low level of evidence, and the poor data analysis of the included studies. The result of each study according to the NOS are shown in Table 1.

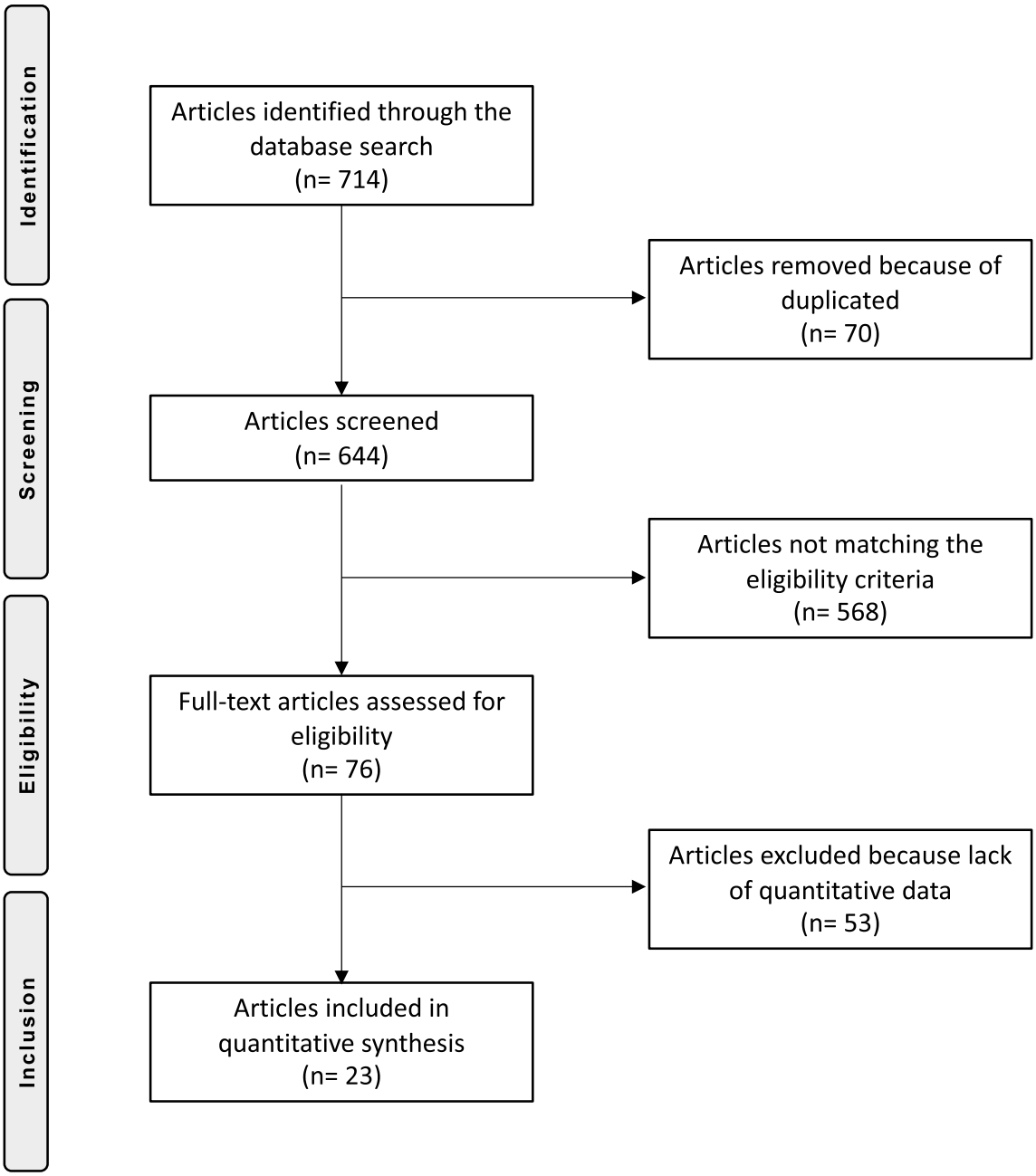

Fig. 1 Flow chart of the literature search

Patient demographic

A total of 28,889 patients were analysed, ranging from amateur to elite level. The mean age was 22.1 ± 3.60 years. We included in our study seven retrospective and 16 prospective cohort studies. The mean injury rate pro 1000 playing hours was 4.21 ± 4.19. The mean follow-up time of the patients was 24.9 ± 39.7 months. Table 1 summarizes the demographic data of the included studies.

Injured areas

The lower limbs were the most affected area ($N = 6688$, 58.3%), followed by the upper limbs ($N = 2220$, 19.4%), the trunk ($N = 1133$, 9.9%), and the head ($N = 321$, 2.8%). Regarding the lower limbs, the most injured area was the ankle ($N = 3311$, 28.9%), followed by the knee ($N = 1666$, 14.5%). Less common injures of the lower limbs involved hip and groin ($N = 337$, 2.9%), thigh ($N = 323$, 1.9%), lower

Table 1 Summary of the demographic data and related NOS of the included studies

Author, year	NOS	League of the samples	Samples (*n*)	Mean age (years)	Follow-up (months)	Injury rate/1000 h
Aagaard et al. 1997 [16]	5	E/R	295	26	24	4.55
Aagaard et al. 1996 [8]	6	E	137	25	24	3.8
Agel et al. 2007 [17]	7	E	3492	–	192	4.34
Augustsson et al. 2006 [9]	5	E	158	–	12	3.78
Bahr et al. 1994 [18]	6	E	318	22	12	0.9
Bahr et al. 1997 [19]	6	E	273	17	12	1.7
Bahr et al. 2003 [20]	4	E	178	–	2	3.1
Beneka et al. 2007 [21]	7	E/R	649	23.51	12	2.35
Beneka et al. 2010 [22]	8	E	407	22	12	2.4
Bere et al. 2015 [4]	6	E	2640	–	48	3.8
Ciesla et al. 2015 [6]	5	E	90	25	–	–
De Loes et al. 1995 [23]	7	–	13,979	17	12	3.4
Foss et al. 2014 [24]	8	R	80	16.5	12	3.68
Haung et al. 2015 [25]	7	E	18	23	>6	–
Malliou et al. 2008 [26]	6	E	689	18.6	12	2.5
Reeser et al. 2015 [27]	5	E	2169	–	48	–
Schafle et al. 1990 [28]	6	R	1520	–	6 days	19.7
Solgard et al. 1995 [29]	7	–	269	23	12	6.5
Tsigganos et al. 2007 [30]	6	E	407	–	12	2.4
Vanderlei et al. 2013 [3]	4	R	522	15	1	–
Verhagen et al. 2004 [5]	8	E	419	24	9	2.6
Watkins et al. 1992 [31]	7	E	86	28	12	–
Yang et al. 2016 [10]	5	E	94	25	12	–

E elite, *R* recreational

leg and Achilles tendon ($N=521$, 4.5%), and foot and toe ($N=235$, 2.0%). The shoulders represented the most common injured area of the upper limbs ($N=1146$, 10.0%), followed by hand and fingers ($N=805$, 7.0%). Less common trauma of the upper limb involved upper arm, ($N=111$, 1.0%), elbow ($N=56$, 0.5%), forearm ($N=19$, 0.2%), and wrist ($N=109$, 1.0%). In the trunk, the recorded injuries concerned mostly the spine ($N=959$, 8.4%), usually in terms of low back pain. Two studies [17, 20] reported abdominal trauma. Less frequently observed injuries were those to the head ($N=321$, 2.8%), face ($N=165$, 1.4%), and neck and cervical spine ($N=144$, 1.3%). An overview of the injured areas is shown in Table 2.

Type of injuries

Joint injuries were the most frequent ($N=4778$, 72.0%), most commonly represented by sprains ($N=2041$, 18.1%) and ligament damage ($N=1924$, 17.0%). Other less common lesions were represented by cartilage damage ($N=19$, 0.2%), tendon damage ($N=495$, 4.4%), meniscus damage ($N=2$, 0.1%), and joint dislocation ($N=170$, 1.5%). Muscle injuries ($N=4387$, 24.0%) mostly involved strain ($N=4271$, 42.4%) and unspecified damages ($N=116$, 1.2%). Bone damages had a low frequency ($N=749$, 7.4%). Among these appeared contusions/concussions ($N=453$, 4.5%) and fractures ($N=379$, 3.8%). Skin lesions were the least common injury in volleyball ($N=69$, 0.7%). The overview of the types of injury is shown in Table 2.

Circumstances

Spiking (55.2%) and blocking (40.4%) represented the two most frequent circumstances in which accidents occurred. Injuries during setting (3.5%) and landing (1.0%) were less frequent. Injuries were more likely to occur in the net zone than in the back row (64.5 vs 35.5%, $P=0.12$). Lesions with an acute onset were more frequent than those caused by overuse (74.7% vs 25.3%, $P=0.3$). Most injuries were not caused by contact with teammates or opponents (64.1% vs 35.9%, $P=0.3$). The overview of the reported circumstances of injuries is shown in Table 3.

Severity of the injury

About a third of the injuries entailed a short-term absence from the game (38.4%). Moderate injuries were the most observed (40.8%) and major injuries were less common

Table 2 Summary of the data concerning type and place of injury

Author (year)	Joint injuries						Bone injuries		Muscle injuries		Skin	Head		Trunk			Upper limb				Lower limb				
	Cartilage	Ligament	Tendon	Meniscus	Sprains	Dislocations	Contusions concussions	Fractures	Muscle injuries	Strains	Cuts lacerations wonds hematomas	Face	Head neck cervical spine	Sternum ribs upper back	Lower back sacrum pelvis	Abdomen	Shoulder clavicula	Upper arm elbow forearm	Wrist	Hand finger	Hip groin thigh	Knee	Lower leg achilles tendon	Ankle	Foot toe
Aagaard et al. 1997 [16]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	26	–	58	7	8	56	14	55	–	65	15
Aagaard et al. 1996 [8]	–	–	–	–	–	–	–	–	–	–	–	–	–	17		–	35	84	–	44	–	37	96	23	20
Agel et al. 2007 [17]	–	1906	259	–	1906	86	141	95	–	1427	–	141	–	–	394	117	539	–	21	166	637	719	191	1651	35
Augustsson et al. 2006 [9]	–	–	–	–	–	–	–	–	–	–	–	1	1	–	19	–	–	16	–	10	2	21	13	28	10
Bahr et al. 1994 [18]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Bahr et al. 1997 [19]	–	–	–	–	58	–	–	–	–	10	–	–	–	11		–	7	–	–	5	3	7	–	53	–
Bahr et al. 2003 [20]	–	–	–	–	–	–	–	–	–	–	–	–	3	2	33	1	20	3	–	8	14	32	4	12	4
Beneka et al. 2007 [21]	16	–	40	–	192	9	–	16	0	68	0	–	–	12	39	–	70	10	–	31	51	60	14	148	
Beneka et al. 2010 [22]	–	–	11	–	118	–	–	33	0	40	0	–	–	12	19	–	28	–	–	22	–	54	–	86	–
Bere et al. 2015 [4]	–	–	–	–	–	–	–	–	–	–	–	20	11	7	45	6	22	7	5	58	31	67	28	114	17

Table 2 (continued)

Author (year)	Joint injuries						Bone injuries		Muscle injuries		Skin	Head		Trunk			Upper limb				Lower limb				
	Cartilage	Ligament	Tendon	Meniscus	Sprains	Dislocations	Contusions concussions	Fractures	Muscle injuries	Strains	Cuts lacerations wonds hematomas	Face	Head neck cervical spine	Sternum ribs upper back	Lower back sacrum pelvis	Abdomen	Shoulder clavicula	Upper arm elbow forearm	Wrist	Hand finger	Hip groin thigh	Knee	Lower leg achilles tendon	Ankle	Foot toe
Ciesla et al. 2015 [6]	28			–	16	9	–	3	0	0	–	–	–	34		–	43	23	18	–	18	63	–	83	–
De Loes et al. 1995 [23]	0	0	0	0	0	0	0	0	0	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Foss et al. 2014 [24]	–	–	–	–	34	–	11	2	–	15	–	–	–	–	–	–	3	–	1	–	–	31	–	3	–
Haung et al. 2015 [25]	–	–	–	–	9	–	–	1	–	16	–	–	–	–	–		4	3	–	5	–	13	3	6	–
Malliou et al. 2008 [26]	–	–	56	–	196	–	–	50	–	46	–	–	–	4	39	–	39	–	–	36	–	64	–	205	–
Reeser et al. 2015 [27]	–	–	30	–	387	–	76	33	–	151	–	–	118	–	163	–	200	–	54	161	190	267	127	523	92
Schafle et al. 1990 [28]	–	–	–	3	43	5	–	5	–	59	3	–	–	–	–	–	13	5	–	10	13	17	7	26	7
Solgard et al. 1995 [29]	–	–	0	–	220	–	22	24	0	23	–	–	–	–	5	–	14		–	120	–	17	–	87	17
Tsiganos et al. 2007 [30]	–	–	11	–	118	–	–	33	–	40	–	–	–	–	31		28	–	–	22	–	54	–	86	–
Vanderlei et al. 2013 [3]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	25		10	19	–	45	

Table 2 (continued)

Author (year)	Joint injuries						Bone injuries		Muscle injuries		Skin	Head		Trunk			Upper limb				Lower limb				
	Cartilage	Ligament	Tendon	Meniscus	Sprains	Dislocations	Contusions concussions	Fractures	Muscle injuries	Strains	Cuts lacerations wonds hematomas	Face	Head neck cervical spine	Sternum ribs upper back	Lower back sacrum pelvis	Abdomen	Shoulder clavicula	Upper arm elbow forearm	Wrist	Hand finger	Hip groin thigh	Knee	Lower leg achilles tendon	Ankle	Foot toe
Verhagen et al. 2004 [5]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	9	7	–	–	–	12	21	41	–
Watkins et al. 1992 [31]	3	18	7	–		1	–	1	9	–	–	–	–	–	8	–	1	–	–	10	–	14	–	12	4
Yang et al. 2016 [10]	–	–	14	–		–	–	1	51	–	–	3	11	4	22	–	–	21	2	16	9	43	3	14	14

(20.8%). The overview of injury severity is shown in Table 3.

Discussion

Based on the main findings of this systematic review, we reported that the most frequently injured area of the body was the ankle, characterized by acute joint sprain. Knees were mostly involved in overuse tendon injury in the male population, while females were more prone to acute ligament tears. Shoulders were another relevant articulation affected by overuse injury, while finger were usually subjecting to fractures. The overall probability of sustaining injury was comparable with other high-performance team sports [7, 32–40].

Concerning the area of the body, according to the current evidence, this study confirmed that the ankle is the most injured area, mostly due to an acute joint sprain. Bahr et al. [18–20] reported that ankle sprain accounted for almost 50% of all acute volleyball injuries resulting in temporary absence. Even if volleyball is considered a non-contact sport, the rate of ankle sprain was comparable to that found in high-contact sports, such as soccer and basketball [16, 18, 19, 28, 41]. Ankle sprain occurred mostly during blocking or landing on the foot of an opponent or a teammate in the net zone [8, 18, 19, 27–29, 31, 42]. The sequence related to the injury is jumping followed by landing and twisting [16, 43]. After the first episode of ankle sprain, the joint undergoes certain pathologic changes that predispose to recurrences, considerably increasing the overall incidence of this pathology [4–6, 8, 9, 16]. A radiologic study [44] reported evidence of ankle spur formations and subchondral sclerosis in high intensity volleyball athletes. Knee joints represented the second most injured area, causing long absence from the field [16]. The study of Geberic et al. [43] evidenced that almost 90% of the injuries requiring hospitalization were knee related. Furthermore, different injury patterns in relation to the players sex have been observed: while males would be more prone to develop jumper's knee, women would be more susceptible to acute knee ligament injuries [45–48]. The jumper's knee is a typical overuse injury, which occurs in sports characterized by repeated and forceful jumping. About 35% of elite players reported suffering from jumper's knee symptoms [16, 47, 49]. This pathology is associated with microscopically damages and subsequent calcifications of the quadriceps tendon enthesis [16, 33, 50]. In female players, a higher prevalence of damage to the anterior cruciate ligament (ACL) has been observed. This occurred mostly during landing. A step-back movement increasing both the valgus and extrarotation of the lower leg can result in an ACL rupture [51]. Overuse shoulder traumas also presented a high incidence in volleyball [9, 16, 17, 22,

Table 3 Summary of the data concerning circumstance and severity of injury

Author (years)	Reference to play event				Court place		Contact			Onset		Severity		
	Spiking	Blocking	Setting	Landing	Net-zone	back row		Non-contact trauma	Contact trauma	Acute	Overuse	Minor	Moderate	Major
Aagaard et al. 1997 [16]	177	115	–	–	292	121		–	83	– 80	80	18	5	–
Aagaard et al. 1996 [8]	57	49	7	–	105	12		–	106	– 71	71	–	150	23
Agel et al. 2007 [17]	–	–	–	–	–	–		3276	1383	– 1245	1245	–	1416	
Augustsson et al. 2006 [9]	16	29	–	–	54	–		–	–	– 48	48	96	25	–
Bahr et al. 1994 [18]	17	37	2	1	54	6		–	91	–	–	34	16	11
Bahr et al. 1997 [19]	56	17	6	–	80	7		–	–	89	0	36	29	30
Bahr et al. 2003 [20]	–	–	–	–	–	–		–	54	– 82	82	–	–	–
Beneka et al. 2007 [21]	–	–	–	–	266	98		283	144	– 117	117	142	240	73
Beneka et al. 2010 [22]	–	–	–	–	258	149		144	55	– 30	30	53	129	34
Bere et al. 2015 [4]	–	–	–	–	–	–		76	101	– 91	91	316	25	10
Ciesla et al. 2015 [6]	–	–	–	–	–	–		102	30	– 91	91	64	34	98

Table 3 (continued)

Author (years)	Reference to play event				Court place		Contact		Onset		Severity		
	Spiking	Blocking	Setting	Landing	Net-zone	back row	Non-contact trauma	Contact trauma	Acute	Overuse	Minor	Moderate	Major
De Loes et al. 1995 [23]	–	–	–	–	–	–	–	–	–	–	–	–	–
Foss et al. 2014 [24]	–	–	–	–	–	–	–	–	–	–	–	–	–
Haung et al. 2015 [25]	–	–	–	–	–	–	–	–	–	–	–	–	–
Malliou et al. 2008 [26]	–	–	–	–	61	125	243	95	279	108	132	221	54
Reeser et al. 2015 [27]	–	–	–	–	–	–	107	–	–	–	–	–	–
Schafle et al. 1990 [28]	29	32	7	–	63	17	–	–	85	69	–	–	–
Solgard et al. 1995 [29]	–	–	–	–	–	–	145	133	−26	26	114		142
Tsigganos et al. 2007 [30]	–	–	–	–	59	162	166	55	191	30	53	129	34
Vanderlei et al. 2013 [3]	–	–	–	–	–	–	48	61	−15	15	–	–	–
Verhagen et al. 2004 [5]	–	–	–	–	–	–	–	78	78	25	–	–	–

Table 3 (continued)

Author (years)	Reference to play event				Court place		Contact		Onset		Severity		
	Spiking	Blocking	Setting	Landing	Net-zone	back row	Non-contact trauma	Contact trauma	Acute	Overuse	Minor	Moderate	Major
Watkins et al. 1992 [31]	12	16	1	6	–		35	11	–	–	29		4
Yang et al. 2016 [10]	–	–	–	–	–	–	–	–	–	–	–	–	–

38, 52], mostly developing into chronic musculotendinous disorders [27, 53]. This may occur during spiking, when the arm is raised in an extremely stressful position. This maximum effort of spiking develops an eccentric overload and repetitive stress on the soft structures of the shoulder [27, 53–55]. Low back pain represented a common cause of complaints among volleyball players, causing disability and absence from the game. Low back pain can be related to repetitive flexions and rotations of the trunk to accommodate high-velocity jump serves from the side. The upper extremities held in front of the body act as a long lever arm, placing considerable stress on the lower back [20, 56]. Schmidt et al. [57], found a correlation between volleyball and development of low back pain: repeated axial loadings and hyperextension movements can lead to microfractures of spine endplate, thus generating low back pain [57, 58]. Moreover, according to Law et al. [59], these endplate defects can lead to medium to long term intervertebral disc degeneration. Finger Injuries reported a high incidence. These were mostly represented by fractures [60] and led to short-term disabilities [8, 16]. Solgard et al. [29] observed that young females had more hand and finger traumas than males. As to be expected, most of the finger injuries occurred during blocking [16, 31], resulting in hyperextension lesions like volar avulsion fractures of the phalanxes [61]. The risk of suffering head trauma or injuries of the elbow, hip and abdomen is very low. Concerning the circumstances and according to the current evidence, this study reported that most injuries occurred in the net-zone and were mostly contactless. These can be secondary to many causes, such as wrong technique, fatigue or inappropriate warm-up. Blocking and spiking were the moments with the highest prevalence of injury. Blocking and spiking can be divided into three separate phases: jump, contact with the ball and landing. While blocking, the fingers, hands and wrists are more vulnerable to injuries due to the high force involved in the impact with the ball [60, 61]. The phase of impact, due to the high forces applied to the ball during spiking, is also related to developing overuse shoulder injuries [53–55]. During landing, the players are particularly vulnerable to ankle sprains, mostly because of the likelihood of landing on the foot of a teammate or opponent [31]. Concerning the types of injury, the most common was represented by the sprain, thus causing the high rate of ankle sprains that characterizes this sport. Furthermore, about a fifth of all observed lesions were represented by muscular strains, thereby representing the second most common type of injury. The severity of the injury correlates with the required duration of recovery time, being suspended from the game. The overall absence time from the game due to injury in volleyball is lower in comparison to other high-performance team sports [7, 34, 39]. Most injuries did not cause a long hiatus from participating in the game, with severe injuries being extremely rare. This

observation is in line with previous studies [4, 6, 17, 21, 22]. This systematic review of the literature presents several limitations. Data from patients is not statistically weighted, and the final evaluation can be negatively influenced by the high level of heterogeneity. Further studies should evaluate data by elaborating the relative error, odd ratio and the heterogeneity coming from the dichotomous comparisons. Another important limitation is represented by the incomparable patient baseline, along with the overall low level of evidence of the included studies. These limitations affect negatively the final effects; consequently, data from this study must be interpreted with caution. Points of strength of the present work are the comprehensive nature of literature search, along with the numerous analysed endpoints.

Conclusion

Though volleyball is commonly considered a safe sport, the overall probability of sustaining an injury is comparable with previous reports from other high-contact team sports. The most injured area of the body is the ankle, characterized by acute joint sprains. Knees are mostly linked to overuse tendon injuries in males, while females are more prone to acute ligament tears. Shoulders are another relevant articulation affected by overuse injuries, and fingers are mostly subject to fractures. Injuries are most frequent in the net zone, seldom resulting in long absence from the game.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study informed consent is not required.

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