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Systematic Review

Incidence of injuries in judo and the potential preventive interventions: A Systematic Review

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Purpose: This systematic review aims to determine the incidence of judo-related injuries among judokas and identify available preventive interventions.
Methodology: A comprehensive literature search was conducted across three electronic databases to identify articles relevant to the topic: PubMed, Scopus, Web of Science and Science Direct. All the articles that met our inclusion criteria were included in the systematic review.
Results: The electronic search yielded 740 articles, of which only 15 met the inclusion criteria and were included in the systematic review. Across the studies, the incidence of judo-related injuries was 15.79 to 71.43 injuries per 1000 athletic events (AEs). The upper and lower extremities were the most injured body parts. The trunk and the head were the body parts that were the least injured among the judokas. Regarding injury type, the most common injuries across the studies were sprains and strains, fractures and contusions.
Conclusions: Our results indicate that the incidence of judo-related injuries is relatively lower than that of other combat sports, such as mixed martial arts (MMA). However, there are inconsistencies in reporting these injuries across the different studies. Future studies should, therefore, adopt a standardized method of reporting outcomes to enable the pooling of results. Lastly, research on the development of injury-preventive interventions in judo remains limited. Consequently, further studies are needed to evaluate and validate various approaches to injury prevention.

Keywords: JUDO; Injuries; Preventive Interventions.

Introduction

Judo is a popular combat sports with approximately 60,000 active judokas worldwide.[1,2] Judo is a martial art that comprises both ground and standing fighting. As a combat sport, the risk of injury is high with every judo game.[3] However, the International Judo Federation has laid out some rules to ensure competitions are conducted safely.
In every competition, all judokas compete in groups categorized based on weight, gender and age.[1] Moreover, a judoka must wear a judo uniform (judogi) for every judo competition and training. The judokas also wear protections such as shin pads, knee pads, and elbow pads for extra safety. To ensure adherence to rules; a referee must inspect the judogi of every fighter together with their protections before the beginning of the game.[4] The referee is required to ensure that the protections worn by the competitors are not made of metallic or rigid parts. If any judoka does not have the prescribed judogi and protection, the referee must issue a warning or disqualify the judoka. After ensuring that all the judokas adhere to the requirements, the referee allows the fighters to compete while overseeing the whole process.[4] While safety regulations are laid for judo sports, injuries are still common in judo, just like in other contact sports.[5] These injuries are mainly due to the close contact between fighters during the sport. This close contact often leads to dental and facial injuries.[6]
In order to aid in the decision-making and rule-setting of judo, various epidemiologic studies have been conducted to determine the prevalence of injuries in judokas.[1] Previous summaries have been conducted to pool the incidence of judo injuries from these studies. Pocecco et al. summarized the incidence of injuries in judo and found that the injuries common in judo included sprains, strains and concussions.[7] Additionally, Pocecco et al. found that the shoulders, knees and hands were the most commonly injured body parts.[1] Later, Mooren et al. did a summary and metanalysis of injuries, specifically focusing on the injuries that occurred during judo tournaments.[8] In their study, Mooren et al. established that the incidence of judo injuries requiring medical evaluation during tournaments ranged from 2.5% to 72.5%.[8] Among these injuries, approximately 1.1% to 4.1% of the injuries resulted in time loss for the Judokas.[8] This review aims to carry out an updated review of these injuries both in training and in the judo tournaments. Furthermore, we aim to establish and propose potential solutions for reducing judo injuries in judokas.

Methodology

Protocol and Registration

This meta-analysis and systematic review were conducted using the guidelines of PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).[9] This review was not registered in any of the databases.

Literature search

The literature search was conducted independently by two reviewers. The search strategy involved two techniques. The first strategy is a well-outlined electronic search using a

predetermined search criterion. This search was carried out on three electronic databases, i.e., PubMed, Scopus, Web of Science and Science Direct and involved the use of the following keywords: ("Judo" OR "Kodokan" OR "Judo athletes" OR "Judo training" OR "Judo competition" OR "Judo techniques" OR "Judo injury prevention" OR "Judo meta-analysis") AND ("Injuries" OR "Trauma" OR "Sports-related injuries" OR "Injury prevention" OR "Safety measures"). After the database search, the reference lists of the obtained studies were manually reviewed to identify additional relevant studies. This enabled us to increase the number of articles obtained from our search.

Eligibility criteria

After obtaining relevant articles, all articles retrieved from the three databases were assessed according to our eligibility criteria. The review included all the studies that met the following inclusion criteria.

1. Population: Studies that included judokas participating in various games or events.
2. Intervention: For the observational studies on epidemiology, no intervention was considered. However, studies that investigated various injury preventive strategies were also included in the analysis.
3. Comparison: The study did not have any comparator that was considered for the epidemiological studies. However, for the interventional studies, we considered those with controls not receiving the preventive strategies.
4. Outcomes: We considered studies that reported outcomes of the injury incidence in their study populations and those that did not.
5. Study design: We included both observational studies and interventional studies.

During the selection process, studies were excluded from our study if they met the exclusion criteria below.

1. Articles not published in the English language.
2. Population: Those studies that did not include judokas as one of the participants.
3. Study design: The study excluded secondary studies such as systematic reviews, case reports, and editorials. Additionally, all conference abstracts lacking full-text articles were excluded.

Data extraction

The independent reviewers conducted the study selection in different phases. The phases entailed the removal of duplicate articles, screening of abstracts and titles, and, lastly, screening of available full texts. For inclusion in the review, the independent authors first screened the articles' abstracts obtained after removing duplicates. If the study met the inclusion criteria, it was included in the study; however, if the reviews could not ascertain its eligibility, they proceeded to obtain the full text for screening. After completing the study selection, the reviewers used pilot-tested data extraction forms to extract all the relevant data from the included studies independently. Outcomes across all the time points were obtained for the analysis. The study data collected from the epidemiological studies included Author ID (first author's last name and Publication year), the study setting, study design, sample characteristics (age and male-to-female ratio, athletic exposure and number or duration of bouts), injury characteristics (body part affected, the types of injuries, and the injury incidence). For the interventional studies, we included the author ID, the study setting, the sample size, the types of injuries, the outcomes reported and the results.

Quality Appraisal and risk of bias assessment.

The quality of the observational studies was assessed using the Newcastle Ottawa Scale (NOS). This scale assesses the quality of the studies using three domains: the selection of participants, the comparability of the study cohorts, and the reporting of the outcomes. The overall quality of the study is then given based on the number of stars the reviewers assign to each domain. The summary of NOS assessments is presented in Table 2. For the interventional studies, the risk of bias (ROB 2) tool provided by the Cochrane Collaboration was utilized to assess the risk of bias. This tool enabled us to determine the risk of bias due to the randomization process, intervention, measurement of the outcomes, and reporting of the outcomes. The risk of bias was classified as either low, some concern or high, based on the reviewers' assessments.

Results

Search results

Our electronic search enabled us to retrieve 740 articles from the databases. The duplication assessment led to the removal of 340 duplicates. The remaining 400 publications were assessed based on title and abstract relevance, leading to the removal of 300 irrelevant abstracts. 100 articles were then sought for retrieval, and all were retrieved and evaluated using our eligibility criteria. Fifteen articles met the inclusion criteria and were included in the review. The remaining articles were excluded for the following reasons: 19 were not published in English, 32 did not include judokas, 17 did not report any of the required outcomes, 4 were case reports, 8 were other secondary studies, and 5 were conference abstracts without the full articles. A PRISMA diagram summarizing the search strategy is presented in Figure 1.

Characteristics of the included studies

This review included 15 studies from different countries across Europe, North and South America, and Asia. However, the participants in the studies were judokas from all over the globe. The included studies comprised 12 epidemiological studies and 3 interventional studies investigating the efficacy of an injury prevention intervention in judokas. The characteristics of the included studies are presented in Tables 1 and 2. Table 1 summarizes observational studies, while Table 2 details interventional studies

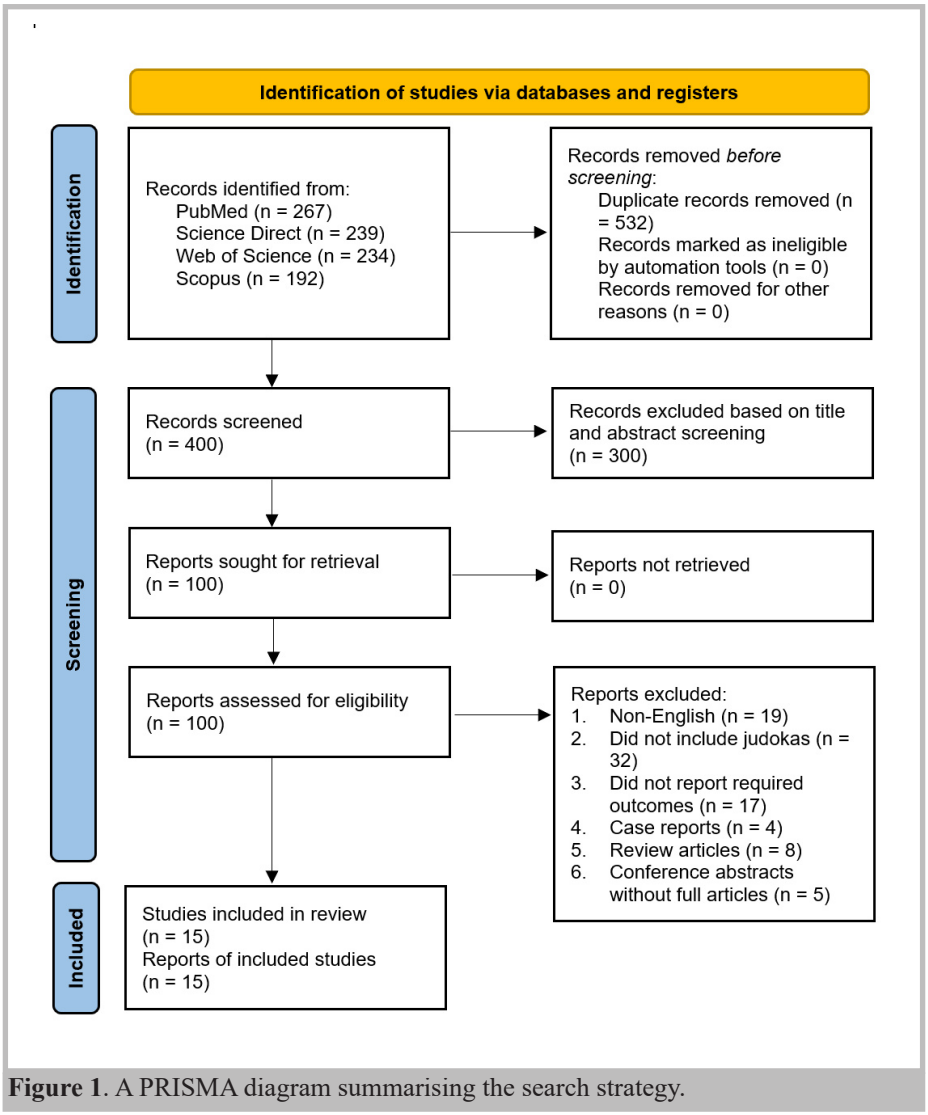

Figure 1. A PRISMA diagram summarising the search strategy.

Table 1. The characteristics of the included observational studies

Author	Country	Participants					INJURIES				
		Mean age [years]	Gender (Male Female) [n]	Athletic exposure		Number of duration of bouts	Location of injuries	Number of cases depending on body part [u] / [%]	Types of Injuries	Number of specific injuries [n] (frequency of occurrence) [%]	Injury rate/1000 athletic exposure
				years	[%]						
Bruggesser et al., 2020.[5]	Switzerland	NR	100 - 282	0.5-2	35.5	56.8% trained once weekly, and 43.3% trained 2 to 7 times weekly.	Limb	52.9	Concussion	4 (8.5)	NR
				2-6	31.2		Face	42.9	Dislocation	1 (2.1)	
				> 6	33.3		Spine, torso, occiput, and neck	4.2	Dental fractures	2 (4.3)	
									Dental avulsions	4 (8.5)	
									Dental avulsion of deciduous teeth	36 (76.6)	
Kamitani et al., 2013.[6]	Japan	7 - 76 (range)	18 (gender not specified)	< 3	60	NR	Cervical spine	100	Cervical spine injury	29 (97)	1.09 per 100,000 per year (Head injury) and 0 per 100,000 for neck injury
			6 (gender not specified)	> 3	20						
			6 (gender not specified)	Unknown	20				Atlantoaxial subluxation	1 (3)	
Fagher et al., 2019.[10]	United Kingdom	18 -42+ (range)	31:14	NR	NR	NR	Vertebral column	7	Inflammation and pain	6 (15.8)	1-year prevalence of 84% (95% CI [71% - 93%])
									Joint derangement.	5 (13)	
							Upper extremities	15	Sprain, strain or rupture	14 (36)	
									Fracture	3 (8)	
							Lower extremities	16	Dislocation	2 (5)	
									Contusion	8 (21)	

Beijsterveldt et al., 2015.[11]	Netherlands	15- 17	311 (gender not specified)	NR	NR	NR	Head and Neck	6	Fracture	2 (5)	NR
									Sprain and strain	15 (64)	
							Torso	9	Contusion	9 (23)	
							Upper extremities	6	Skin injury	5 (13)	
							Lower extremities	18	Muscle injury	3 (8)	
									Others	5 (13)	
Maciejewski et al., 2016. [12]	Philippines	7+ (range)	302 (gender not specified)	NR	NR	NR	Head and neck	10	Abrasion	3 (10)	Senior men 71.43/1000 AEs, senior women 51.47/1000 AEs, Junior Men 22.73/1000 AEs, and junior women 15.79/1000 AEs
									Concussion	1 (3)	
									Contusion	5 (17)	
							Upper body	3	Cramps	1 (3)	
									Dislocation	3 (10)	
									Hyperextension	2 (7)	
							Lower body	15	Ligament tear	1 (3)	
									Sprain	11 (38)	
									Others	1 (3)	
Machado et al., 2019.[13]	Brazil	NR	2890 (gender not specified)	NR	NR	NR	Head, face and neck	125/NR	Bruise	197 (42)	NR
							Trunk and Genitalia	7/NR	Laceration	79 (17)	
							Upper extremities	224/NR	Abrasion	58 (12)	
							Lower extremities	91/NR	Others	135 (29)	

Cierna et al., 2017.[14]	Slovakia	NR	295 (gender not specified)	674 athletic exposures.		2202 athletic minutes	Head and neck	11/NR	Contusion	8 (33)	35.6 per 1000 AEs, and 10.9 per 1000 Athletic minutes.
									Dislocation	4 (17)	
							Upper limb	9/NR	Laceration	4 (17)	
							Trunk	-	Sprain	3 (13)	
							Lower limb	4/NR	Concussion	1 (4)	
									Others	4 (17)	
Frey et al., 2019.[15]	France	NR	316 - 203	NR	NR	NR	Upper limb	1646 / 56	Sprain	1907 (54.3)	NR
							Lower limb	737 / 25.4	Fracture	548 (15.6)	
							Cervical spine	323 / 11.1	Dislocation	439 (12.5)	
							Rib	129 / 4.4	Muscle Injury	245 (7.0)	
							Face	54 / 1.8	Others	372 (10.6)	
Kinoda et al., 2024.[16]	Japan	19.8 ± 1.2	376 - 183	NR	NR	NR	Head	23	NR	NR	NR
							Trunk	61 / 10.5			
							Upper limb	195 / 33.6			
							Lower limb	302 / 52.0			
Blach et al., 2021.[17]	Europe	NR	384 - 315	NR	NR	NR	Head and neck	161 / 23	Sprain	293 (51)	The incidence of injuries requiring medical attention was 2.5%.
							Upper body	144 / 21	Luxation	61 (11)	
							Upper limb	158 / 23	Fracture	30 (5)	
							Lower limb	209 / 30	Contusion	160 (28)	
							Others	21 / 3	Others	28 (5)	

Kim et al., 2021.[18]	Korea	NR	232 (gender not specified)	NR	NR	NR	Lower extremities	38.12	NR	NR	The average incidence was 2.61 injuries per athlete
							Upper extremities	36.80			
							Trunk	17.66			
							Head and Neck area	7.43			
Akoto et al., 2017.[19]	Europe	NR	2962 - 2816	NR	NR	NR	Upper extremities	41	Unspecified knee injury	794 (17)	NR
									Joint dislocation	531 (11)	
									Unspecified shoulder injury	518 (11)	
							Lower extremities	39	Anterior crucial ligament rupture	500 (11)	
									Ligament injury of the ankle/foot	468 (10)	
									Shoulder Dislocation	293 (6)	
							Head	5	Clavicle fracture	256 (5)	
									Rib fracture	252 (5)	
									Concussion	217 (5)	
							Trunk	16	Ligament injury of the elbow	203 (4)	
									Meniscus injury	202 (4)	
									Vertebral disc prolapses	190 (4)	

Note: NR – Not reported.

Table 2. Characteristics of the included interventional studies

Study	Country	Sample Size (n)	Study Design	Type of Injury	Outcomes
Gerhardt et al., 2023.[20]	Netherlands	269	RCT	Judo-specific injury	The overall and severe injury prevalence did not significantly decrease with the IPPON intervention
Arkkukangas et al., 2021.[21]	Six EU countries	142	RCT	Judo injuries	The groups in this exercise program under study differed significantly regarding strength, balance, and safe falling techniques
Rawat et al., 2024. [22]	NR	20	Quasi experimental trial.	Judo Injuries	The judo+ injury prevention training improved the fitness of the elite judokas in terms of limb strength and anaerobic fitness. However, it failed to improve their balance

Note: NR – Not reported.

Methodological quality and risk of bias

The methodological quality of the observational and intervention studies was generally good, except for one study by Rawat et al.[10] (Table 3).

Table 3. A Newcastle Ottawa Scale indicates the methodological quality of the included studies

Author	Selection	Comparability	Reporting	AHRQ standard
Bruggesser et al., 2020.[5]	2	2	3	Good
Kamitani et al., 2013.[6]	2	1	3	Good
Fagher et al., 2019.[10]	3	2	3	Good
Beijsterveldt et al., 2015.[11]	3	1	3	Good
Maciejewski et al., 2016.[12]	4	2	3	Good
Machado et al., 2019.[13]	3	2	3	Good
Cierna et al., 2017.[14]	3	2	3	Good
Frey et al., 2019.[15]	3	2	3	Good
Kinoda et al., 2024.[16]	3	2	2	Good
Blach et al., 2021.[17]	3	2	3	Good
Kim et al., 2021.[18]	3	1	3	Good
Akoto et al., 2017.[19]	3	2	3	Good
Rawat et al., 2024.[22]	2	1	2	Fair

The risk of bias in two randomized studies was assessed as having "some concerns" overall. The concerns were due to "some concerns" on deviations from intended intervention domain (Figure 2).

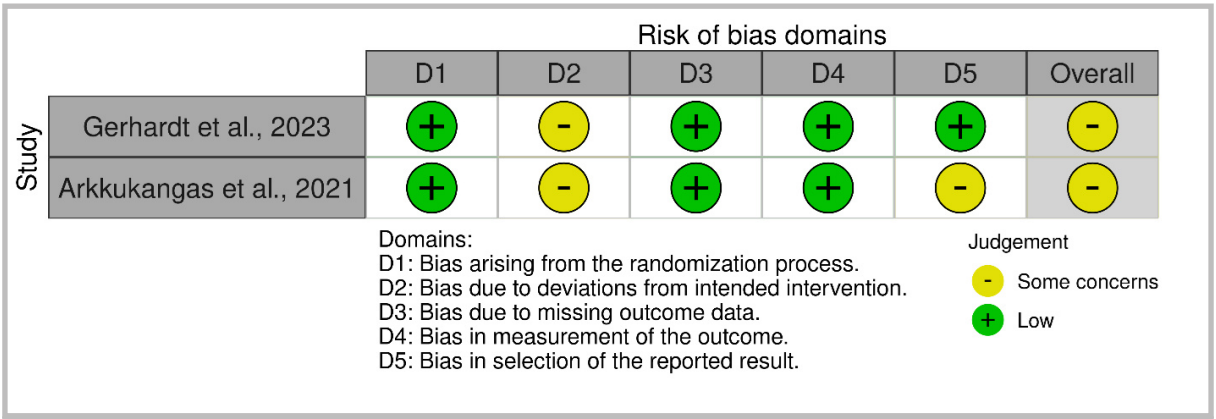

Figure 2 The risk of bias of the included randomized controlled trials[16,17].

Injury incidence

The studies' reporting of the incidence of injuries was highly varied. For those that reported the incidence as the number of injuries per 1000 AEs, the incidence of all types of injuries ranged from 15.79 to 71.43 injuries per 100 AEs.[11,12] This incidence increased as the age of the judokas increased. Additionally, injury incidence was higher in males compared to females. Another study, which estimated the one-year prevalence of judo injuries, found that about 84% of the judokas had some form of injury within one year. However, the study was based on a small sample size and thus, the generalizability of its results is limited.[13] Studies reporting injury as a percentage of affected judokas found that approximately 2.5% sustained injuries during training or competitons.[14] Furthermore, another study established that the average number of injuries per judokas is 2.61.[15]

Body parts affected

Most of the studies categorized their injuries according to the body parts affected. Generally, the body was classified into the head, neck, spine, upper and lower extremities, and trunk. In all studies, the extremities were the most commonly injured body parts. The rate of injuries in the lower extremity ranged from 25% to 52%. In the upper extremities, the rate of injuries ranged from 23% to 41% of all the injuries. Lower rates of injuries were reported in the trunk (4.2% to 17.66%) and the head and neck (5%-23%). One study reported a 100% incidence of cervical spine injuries; however, this study exclusively included judokas with cervical spine injury and thus, its generalizability is limited.[6]

Types of injuries

Similar to all the other aspects of judo injuries, we found different incidences of different injuries in judokas. The most common injuries included sprains and strains (13% to 64%), fractures (5 – 56%), contusions (17-33%), cervical spine injuries (97%), and concussion (3-8.5%). We did not find the severity of these injuries since most studies did not estimate how severe these different types of injuries were. No data were found on the impact of injuries on the judokas' quality of life or competitive performance.

Preventive strategies

After establishing the incidence of judo injuries, we also sought to find any valuable and effective interventions to prevent and reduce the occurrence of judo injuries. We found only three studies that investigated judo-based interventions to reduce the occurrence of injuries. The study by Gerhardt et al.[16] involved implementing an injury prevention intervention, in recreational judokas. They found that the interventional group had lower rates of judo injuries than the control group. However, these differences were not statistically significant.[16] The second study was quasi-experimental, investigating the judo 9+ intervention in preventing injuries in elite judokas. The study found significant benefits from the judo 9+ intervention. The study lacked a comparator and thus did not provide the comparative benefit of the judo 9+ interventions.[10] The third study, which did not involve elite judokas, used judo-based exercises to prevent fall-related injuries. The study found that judo-based exercises increased fitness and thus prevented the occurrence of injuries from falls in the elderly population[17].

Discussion

This systematic review aimed to establish the incidence of judo injuries in judokas during practice or training. Furthermore, we aimed to establish the different interventions that can be implemented to reduce the incidence of these injuries. We found that the incidence of injuries ranged from 15 to 71 injuries per 1000 AEs. Furthermore, while interventions aimed at preventing injuries in judo have been tested, their efficacy remains inconclusive.

Occurrence of injuries

The occurrence of injuries in combat sports and sports, in general, is one of the main concerns of most sports associations and federations. The incidence of injuries in judo is relatively low compared to other combat sports. A previous systematic review found that the incidence of injuries in boxing and taekwondo in the Olympics was higher than in judo.[18] Furthermore, while our study reported 15 to 71 injuries per 1000 AEs, other reviews have established higher incidences in other sports. In mixed martial arts (MMA), Lystad et al. found that the incidence of injuries was between 110.4 and 473.5 per 1000 AEs.[19] However, the definitions of injuries in the various primary studies and reviews are different and inconsistent, which affects the comparability of the results.

It is proposed that the lower incidence of injuries in judo compared to these other sports is due to the difference in the practice and rules of the sports. For example, in MMA, competitors are permitted to strike and kick, and matches often consist of multiple rounds, increasing the risk of injuries due to greater athletic exposure. This therefore increases the athletic exposure of MMA fighters and predisposes them to injuries.[8] The prevalence of injuries in judo, even though lower compared to most other sports, is still higher compared to some other sports, such as Brazilian jiu-jitsu (BJJ). The rate of injuries in BJJ athletes has been reported to be as low as 9.2 per 1000 AEs.[20] Compared to judo, which is practiced while standing, BJJ

is rolling, which may explain the lower incidence of injuries.

Injury types and location

Our review found that the body location with the most types of injuries was the extremities. Similarly, Pocecco et al.[7] reported a higher incidence of injuries in different parts of the extremities, including the knees, hands/fingers and shoulders. Contrary to the findings of these two reviews, another review by Mooren et al. found that the most common injuries during judo competitions were to the head.[8] However, Mooren et al. noted that most head injuries during judo competitions were minor and did not require medical attention. This indicated that the number of head injuries reported were minor and did not significantly affect the judoka's life.[8]

Regarding the type of injuries, our study found that strains and sprains were the most common injuries in judokas across multiple studies. Similarly, the review by Mooren et al. found sprains to be the most common type of injury in judokas.[8] Furthermore, sprains were attributed to be the type of injuries that resulted in the most loss of time.[8] The second most prevalent injuries in our review were fractures and contusions. Similarly, the previous reviews found contusion as the third most common type of injury in judokas.[7] However, none of the previous reviews found fractures to be one of the most common types of injury. Even though our study found fractures to be one of the most common types of injuries, it was reported on a limited number of studies.

Prevention of injuries

Safety is one of the major emphases of judo federations. One of the main ways that judokas are aided to ensure their safety is practicing ukemi, i.e., safe falling before participating in any judo competitions.[21] Good perfection of ukemi has been shown to improve the safety of judokas while at the same time reducing their risk of having neck injuries.[22] Ukemi is a standard practice in judo, so we sought to identify any other safety interventions. We found only two interventions: the IPPNO intervention and the judo 9+. Both these interventions were found to improve the performance of judokas and could reduce the incidence of injuries.[10,16] However, a significant benefit from the intervention compared to the controls is yet to be observed in the judokas.[16] These two studies are the only preliminary evidence of any scientific interventions aimed at reducing the incidence of injuries in judokas. Further research is therefore required to establish their efficacy in judokas since judo-based exercises effectively reduce injuries even in non-judokas, such as the elderly.[23]

Limitations of the study

The current review had some limitations. First, the variability in reported results prevented pooling of injury incidence data among judokas. This hindered our ability to determine the precise incidence of injuries among judokas. Secondly, while the epidemiological studies were a good number, the number of interventional studies was limited. We found only two studies focusing on the interventions for preventing injuries in judokas and one study using judo-based exercise to prevent injuries. These limited studies offer insufficient evidence regarding the effectiveness of interventions in preventing judo injuries.

Practical application

The study's findings offer practical guidance for reducing judo-related injuries through targeted training programs focused on extremity strength and flexibility. Preventive strategies, and enhanced ukemi practice, can be integrated into coaching routines to improve safety. These insights support the development of injury prevention protocols, helping athletes maintain performance and extend their careers.

Conclusions

Our study found that the incidence of injuries among judokas is 17 -71 injuries per 1000 AEs. Furthermore, the commonly affected parts of the body were the extremities, with the most common types of injuries being sprains and strains, fractures, and contusions. However, the reporting of judo injuries across various epidemiological studies is varied, making it difficult to pool the results. We recommend that future studies adopt standardized injury reporting methods to facilitate secondary analysis and improve comparability. Regarding the interventions in preventing judo injuries, we found limited evidence of the effectiveness of different interventions in preventing injuries. Although preliminary evidence suggests potential benefits of these interventions, further research is necessary to confirm their effectiveness and develop robust preventive strategies.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Ethical Committee approval

No Ethical Commitee approval required as it was a systematic review

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Conflicts of interest

The authors have no conflicts of interest to declare.

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Author-s contribution

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