

EPIDEMIOLOGY OF JUDO INJURIES IN SENIOR AND JUNIOR JUDOKA

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- risk factors,
- athletes.

Abstract:

Aim: The purpose of this study is to assess the injury profile in senior and junior judoka in competition. *Material and methodology:* Participants were Filipino judo athletes (n= 302) competing in the 2014 Philippine National Games held in Manila. A simple injury form was used to obtain information regarding common body parts injured, types of injury, situations and mechanisms of injury, and time to injury. Case-rate per 1,000 athlete-exposures (A-E) was the method used to report injuries. Odds Ratios (OR) and Relative Risks (RR) were calculated as well as 95% confidence intervals around the rates. *Results:* There was a significant difference in injury rate between senior (71.43/1,000 A-E; 95%CI: 32.60-110.26) and junior men (22.73/1,000 A-E; 95%CI: 2.81-42.65) at OR=3.73; 95%CI: 1.27-11.00; $p= 0.02$. A significant difference was also found between the senior men and the junior women (15.79/1,000 A-E; 95%CI: -2.08-33.66) at OR= 5.10; 95%CI: 1.39-18.73; $p= 0.01$. Upper body injuries in the senior men were significantly higher than lower body injuries, (RR= 3.2; 95%CI: 1.14-9.24; $p= 0.03$). Performing a throw (34%) was the most common situation when an injury occurred and impact on the surface (29%) was the most common mechanism. Most injuries were sustained during the first part of the competition (82%). Weight loss was not found to influence susceptibility to injury. *Conclusion:* Adult male judoka has a higher risk of injury compared to their younger and sex counterparts. Injuries to the upper body, performing a throw and impact on the surface were mostly involved in injury occurrence.

INTRODUCTION

It has been more than four decades ago since the first scientific papers in English concerning judo injuries were published (Elliot 1972; Weightman, Browne 1975). Since then, publications were sparse and largely far in between. The earliest ones were case reports (Elliot 1972; McLatchie 1979; Nishimura 1988; Russo Maffulli 1991). Although this kind of studies continued and has significant contribution in terms of identifying risk factors as well as clarifying mechanisms of injury (Brooks, Fuller 2006), prospective designs (Pieter, Talbot 2001; James, Pieter 2003; Green et al. 2007; Kim et al. 2015) and retrospective designs (Barsottini et al. 2006; Souza et al. 2006; Oliveira, Pereira 2008; Koshida et al. 2010)

dominate the later and recent publications. The few prospective studies done on Asian athletes were in the elite level (Kim et al. 2015; Pieter et al. 2001).

Understanding the nature of injuries occurring in competition for non-elite athletes will help in the prevention of injuries that may influence continued participation. Several studies in the west have reported injuries incurred in this population (Green et al. 2007; Barsottini et al. 2006; Souza et al. 2006). There has been an increase in participation in judo in the Philippines more than five years ago [San Juan 2010]. A cross-sectional study of injuries incurred by a collegiate team at a collegiate level was published in a local journal (Atlas et al. 2007). However, injury studies on a national level are warranted to have more representative information on judo injuries.

The aim of this study was to provide epidemiological data on injuries incurred by young and adult judokas in a national competition. These data included common body parts injured, types of injury, situations and mechanisms of injury, and time to injury. Aside from comparing injury rates by gender, relationships of incidence rates to weight category and weight loss were also examined.

MATERIALS AND METHODOLOGY

Participants

Data were collected from participants (n=302) during the national judo competition in the Philippines in 2014. There were three major divisions in most tournaments based on age: the senior division was open, the junior division was from 16-19 years, and the boys and girls was from 7-15 years. Only the first two divisions, senior men (n=75), senior women (n=57), junior men (n=94), and junior women (n=76) were included in this report. A separate event was sometimes held exclusively for children. All athletes needed to make the weight a few hours before the start of competition. There are eight weight categories for each division. Participants were coming from all over the country, usually representing the different regional provinces. A written informed consent form was accomplished by all subjects. This study was approved by the Philippine Judo Federation.

Injury definition

An injury was defined as all cases that were brought to the attention of the medical personnel during the competition. Case-rates per 1,000 athlete-exposure (A-E) was the method used to report injuries. A-E is defined as “one athlete participating in one practice or game where there is a possibility of sustaining an athletic injury” [Zemper, Dick 2007: 11].

Data Collection

An on-site injury survey was conducted during the competition. Recording of data took place whenever an athlete sought medical attention from the medical table. All identified injuries were diagnosed by the medical staff. Other information associated with the injury was sought from the injured athlete while being treated. Injury information included body part injured, type of injury, injury situation and mechanism, time of injury, acute or chronic injury, and whether an injury allowed an athlete to continue or not in a match or competition. Survey items were based on those used in previous studies (Pieter et al. 2001; Maciejewski, Callanta [in submission]; San Juan, Pieter 2014; San Juan et al. 2011).

Analysis

In a judo match, two athletes are exposed to the possibility of getting injured. Hence, there are two counted A-Es for every match. The basic formula used to calculate incidence rates was: (number of injuries x 1,000 A-E) /total number of athletes at risk. Incidence rates were calculated as well as the confidence intervals for each rate. Odds ratios were computed

around the rates and, when applicable, relative risks. All analyses were done using Stat Pac version 4.0 Copyright 1997-2016, Stat Pac, Inc., Pepin WI.

RESULTS

A total number of 28 injuries were recorded among 302 judo athletes. Table 1 shows the injury rates (95%CI) in senior as well junior men and women. A comparison of the injury rates between the senior athletes shows that the men had a higher risk than the women (OR=1.50; 95%CI: 0.56-4.04) and the women were at a higher risk than the junior men (OR=2.50; 95%CI: 0.75-8.26) and junior women (OR=3.41; 95%CI: 0.84-13.81). These relationships, however, were not statistically significant. However, the difference between senior and junior men were significant (OR=3.73; 95%CI: 1.27-11.00; *p*= 0.02). Similar findings were found between senior men and junior women (OR=5.10; 95%CI: 1.39-18.73; *p*= 0.01).

Table 1. Injury rates (95%CI) in Senior and Junior Men and Women

	Senior Men	Senior Women	Junior Men	Junior Women
No. of Athletes	75	57	94	76
A-E	182	136	220	190
No. of Injuries	13	7	5	3
IR per 1,000 A-E	71.43 (32.60-110.26)	51.47 (13.34-89.60)	22.73 (2.81-42.65)	15.79 (-2.08-33.66)

Note: CI: confidence interval; A-E: athlete-exposure; IR: injury rate

Figure 1 shows the upper body got injured more than half of the time (53%) compared to the lower body and the head and neck regions. The senior men had significantly more cases of upper body injuries (49.45/1,000 A-E; 95%CI: 17.14-81.76) compared to the lower body (16.48/1,000 A-E; 95%CI: -2.17-35.14), RR= 3.2; 95%CI: 1.14-9.24; *p*= 0.03. This observation was not shared by the senior women (RR= 1.00; 95%CI: 0.35-2.88; *p*= 1.00), the junior men (RR=1.00; 95%CI: 0.28-3.54; *p*=1.00), and the junior women (RR= 2.00; 95%CI: 0.33-11.97; *p*= 0.45).

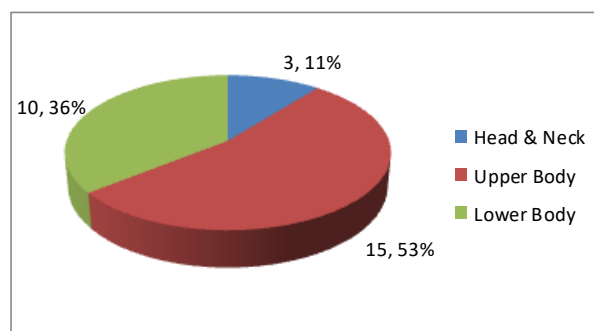


Figure 1. Number and percentage distribution of injuries by body region across all sex groups

Table 2 shows the types of injury sustained by all participants. Contusion had the highest injury rate in senior men, while sprain was higher for both senior women and junior men. The difference, however, between the rates was ambiguous.

Table 2. Injury rates (95%CI) by injury types in Senior and Junior Men and Women

Injury Type	SM		SW		JM		JW	
	No.	Rate (95%CI)	No.	Rate (95%CI)	No.	Rate (95%CI)	No.	Rate (95%CI)
Abrasion	1	5.49 (-5.27-16.26)	2	14.71 (-5.68-35.09)	0	0.00	0	0.00
Concussion	0	0.00	0	0.00	1	4.54 (-4.36-13.45)	0	0.00
Contusion	4	21.98 (0.44-43.52)	0	0.00	0	0.00	1	5.26 (-5.05-15.58)
Cramps	1	5.49 (-5.27-16.26)	0	0.00	0	0.00	0	0.00
Dislocation	3	16.48 (-2.17-35.14)	0	0.00	0	0.00	0	0.00
Hyperextension	1	5.49 (-5.27-16.26)	1	7.35 (-7.06-21.76)	0	0.00	0	0.00
Ligament tear	1	5.49 (-5.27-16.26)	0	0.00	0	0.00	0	0.00
Sprain	2	10.99 (-4.24-26.22)	4	29.41 (0.59-58.23)	4	18.18 (0.36-36.00)	1	5.26 (-5.05-15.58)
Others	0	0.00	0	0.00	0	0.00	1	5.26 (-5.05-15.58)

Note: SM: senior men; SW: senior women; JM: junior men; JW: junior women; CI: confidence interval

Performing a throw (34%) and grappling (25%) were the most common situations the athletes have been found to sustain an injury, followed by being thrown (14%), prohibited action (7%), and other situations (21%), such as defending from a throw, movement on the mats (*tsugi-ashi*), uniform-related situation, etc. On the other hand, impact on the mat surface (29%) was the most common cause of injury across age and sex categories, followed by delivering a throw (18%), receiving a throw (11%), delayed abandonment (11%), delayed referee action (4%), no evidence of contact (4%), and other injury mechanisms (25%), such as unusual positioning of arm or leg, mat burns, attempts to escape from a hold, gripping (*kumikata*), etc.

Most injuries were sustained during the first part of the competition during the elimination and quarterfinal rounds (82%) compared to those incurred at the latter part of the competition during the semifinal rounds and repechage matches (18%). More than half of the injuries were new injuries (54%) while others were either a recurrence from the present season (11%) or the previous seasons (36%).

46% of those who got injured won their matches, 43% got injured and lost, and 11% had to discontinue the match. Concerning weight categories, the athletes were divided into light, medium, and heavy weights. Light weight athletes got injured 39% ± 19.28% of the time (95%CI: 19.72-58.28), medium weight athletes 43% ± 19.57 (95%CI: 23.43-62.57), and heavy weights 18% ± 15.189 (95%CI: 2.81-33.19).

DISCUSSION

Total Injury Rates

The overall injury rates for both male and female participants in this study are comparable to those published previously [Pieter et al. 2001; James, Pieter 2003; Green et al. 2007]. However, compared to a study by Maciejewski and Callanta [in submission] using the same population in 2009, the injury rates in this most recent survey were so much lower (98.25/1,000 A-E; 95%CI: 77.95-118.55). The reason for this is not clear, but some factors investigated in other combat sports found the changes in game rules to influence injury risks [Macan et al. 2006]. In judo starting in 2010, some rule changes have been implemented by the International Judo Federation. One of these was the prohibition of leg grabbing which initially could still be used as a follow-up or a combination technique but was later completely declared illegal. These changes, however, were not specifically enforced to lower injury risks, but to bring quality back to the play of judo.

Although not found to be significant, older participants in this study were found to incur more injuries than their younger counterparts. A possible reason may be attributed to the higher level of confidence by the senior athletes to initiate and perform novel movements. Also, longer experience can be equated to longer exposure to the risk of getting injured.

Baćanac et al. [2007], however, found mixed results with a decreased susceptibility to injury among experienced men and an increased percentage of injury for women with experience longer than 5 years.

The same trend was seen in the role of sex in injury occurrence. Harmer [2010] pointed out the differing results in the literature when it comes to this intrinsic factor. Some studies found consistent higher injury rates among female athletes (girls: 98.6/1,000 A-E; junior girls: 150/1,000 A-E; Women: 125/1,000 A-E) [Pieter, De Créé 1997] but not in others (34.25/1,000 A-E) [James, Pieter 2003].

Body Part/Region

The upper body was found to be at a higher risk for injury than the lower body or the head and neck in this study. This observation was reported as early as forty years ago when causes for injuries to the upper limb were described by Elliot [1972]. Similar findings were reflected in other studies [James, Pieter 2003] and in comparison of different martial arts [Pieter 2005]. The nature of the sport may contribute to an increased risk of injury for this body region. Judo starts and usually finishes in a standing position. The only way that two contestants can affect a control on each other is by way of *kumikata*. Injuries to the wrist, fingers, elbow, and even shoulders may stem from each judoka trying to gain an upper hand. The bad falls can also endanger the upper extremities, especially when the falling skill (*ukemi*) of a judoka is not yet well-developed. A few case reports explore this mechanism [Russo, Maffulli 1991].

Most recent studies, however, identified the lower body to be most susceptible to injury. Kim and colleagues [2015] reported higher injury rates in the lower body in both men and women athletes, 145 recorded injuries at 38.3/1,000 hours of training and 177 recorded injuries at 43.9/1,000 hours of training, respectively. Although this data cover training injuries, more injuries are said to occur in competition. In a survey of different martial arts and combat sports including judo, Cynarski and Kudlacz [2008] reported that the majority of injuries did occur during fights.

Concerning the lower body, the knee was found to be most prone to harm [Kim et al. 2015]. In an earlier investigation of knee injuries among judoists in Japan, the most common cause is being “crushed” when attempting to perform a throwing technique [Shimokawa et al. 2001: 7]. Regarding the head and neck, injuries to this body region was the lowest injury rate in the current study. Similar findings were shared by other prospective studies in judo [Pieter, De Créé 1997; Pieter et al. 2001; James, Pieter 2003] except one by James and Pieter [1999] where head and neck was the most injured body region for boys at 16.20/1,000 A-E; 95% CI: 9.43-22.97). The general low rates of injury to this body region, despite constant exposure to possible head trauma in rolling and throwing, reflect the accepted emphasis on falling skills in all judo practice. In fact, in a recent literature review of injuries in judo, improving falling skills was the first prevention measures highlighted to reduce upper body injuries [Pocecco et al. 2013].

Types of Injury

Contusion and sprain were the most common injury types across all sex groups presented in this study. These injuries were usually caused by collision of body parts. Body contact in most judo techniques is essential in the successful execution of a throw [Kodokan Judo 1986: 44]. Among the three elements of performing a throw, body contact which is the goal of the second phase (*tsukuri*) gives an opportunity for many collision injuries such as contusion. Sprain often results from the application of opposing forces on the joints such as when a judoka, in the act of pulling in one direction, finds himself being pulled back towards the other direction. The same injuries were generally more common in the judo literature

[Pieter, De Créé 1997; Pieter 2005] as well as other martial arts studies [Kujala et al. 1995; Kudlacz, Cynarski 2007].

It should be noted also that in the present study 3 incidences of dislocation happened in the competition. This kind of injury is considered severe for it would require stoppage of the match and the injured athlete not allowed to continue in the game. Some studies concluded that fewer serious injuries take place in judo competitions [Pieter et al. 2001]. Indeed, Nishime [2007] citing several sources proposed its relative safety for young people.

Injury Situation and Mechanism

The results of this study reiterate what can already be found in the literature regarding the most common situations leading to injury. Since performing a throw has the highest injury rate compared to other situations, it seems that those judokas who are active during the match, the one constantly attacking and looking for opportunities, were the ones who also got injured the most. Barsottini et al. [2006] found the one-shoulder throw (*ippon-seoi-nage*) to be the cause of 23% of the injuries surveyed. This was followed by body drop (*tai-otoshi*) and inner-thigh throw (*uchi-mata*). Koshida et al. [2008] identified major outer reaping (*osoto-gari*) as well as *tai-otoshi* as the most common causes of ACL injury in high school and collegiate athletes.

On the other hand, grappling injuries were also found to occur a lot. At the elite level, Pieter et al. [2001] reported groundwork as a major injury mechanism for females and executing a throw for males. Impact with surface was the most common mechanism of injury in this study. Whether an athlete falls on the mats because of throwing, defending, or being in an unbalanced position, the results are sometimes severe such as fracture of the ulna, clavicle, or even foot. The mats help prevent these kinds of injury from occurring, but in most training halls (*dojo*) mats are old and hard. Injuries in grappling may also be due to an over-eager opponent who applies too much force and speed in the execution of an arm lock. It can also be due to an incompetent referee who is not well-versed with the rules.

Time to Injury, New Injuries, Results of Injury, Weight Loss

A significant difference was found in this study between injuries occurring during the first part of the competition and those occurring in the latter part of the tournament. Among the studies surveyed, there was none yet exploring time to injury as a risk factor. It is not unreasonable to assume that factors, such as anxiety and other mood states prior to a match, may affect the athlete's state of physical and psychological readiness for any eventuality during the game. Several studies have explored the relationship of mood states and performance [Wong et al. 2005]. The "ephemeral" characteristic of mood as defined by Lane and Terry [2000: 16], subject to fluctuations, can alter an athlete's behavior and disposition. The proposed model of stress and athletic injury by Andersen and Williams [1993] may help examine the time element involved in injury occurrence.

In the current study, no difference was found between new injuries and old, recurring injuries. Anecdotal evidences, however, suggest that many judo athletes compete with existing injuries, even major ones. Referring to the results of injury, no difference in injury occurrence was found between winners and losers. It should be noted, however, that not all injuries are reported, no matter the severity, as observed by Birrer and Birrer [1983]. In regard to weight loss and injuries, no difference was found between those who lost weight for the competition and those who did not. Green et al. [2007], however, reported that 27.5% of those who lost weight sustained an injury in the competition, concluding that losing at least 5% of one's body weight increases risk of injury.

Comparison to Karate and Taekwondo

Table 3 shows a comparison of total injury rates in this study with two other recent studies in combat sports injury. The rates in judo is significantly lower compared to karate (Males: OR= 4.49; 95%CI: 2.56-7.88; p<0.00 vs Females: OR= 7.57; 95%CI: 3.47-16.52; p<0.00) and taekwondo (Males: OR= 2.10; 95%CI: 1.13-3.89; p= 0.02 vs Females: OR= 4.54; 95%CI: 2.05-10.07; p= 0.00). This is not surprising considering that the goal of karate and taekwondo in competition is different from that in judo. Karate and taekwondo are considered striking sports. The contestants used their hands and feet to punch and kick, respectively. Judo aims to bring the opponent down on the mats or make an opponent submit through choking and arm lock. To accomplish this, judokas need to make a lot of preparations to perform an effective throw or an arm lock. In karate and taekwondo, the athletes spend most of the time throwing out kicks and punches.

Table 3. Comparison of total injury rates in three combat sports

	Male		Female	
	No. of injuries	IR (95%CI)	No. of injuries	IR (95%CI)
Judo [this study]	18	44.78 (24.09-65.46)	10	30.67 (11.66-49.69)
Karate [Pieter 2010]	76	99.74 (77.32-122.16)	32	115.11 (75.23-154.99)
Taekwondo [Pieter, Kazemi 2007]	34	134.62 (64.10-205.14)	24	333.33 (170.00-496.66)

Note: IR: injury rates; CI: confidence interval

In terms of body region, the upper body sustained most injuries in judo, the head and neck in karate, and the lower body in taekwondo. With respect to injury types, sprain was the most common in judo, contusion in karate and taekwondo. These outcomes reveal that the nature of the sport has an influence on the types of injuries incurred [Cynarski, Kudlacz 2008]. These findings are also reflected in other studies in these combat sports [Beis et al. 2001; Arriaza, Leyes 2005].

The injury situation and mechanism in judo mostly involved the act of throwing and impact on the surface of the mats. In karate, attacking with a straight punch and simultaneous attacks were the most common cause of injury. In taekwondo, the use of the roundhouse kick was implicated in most injuries.

CONCLUSION

Compared to other combat sports, judo seems to have lower injury rates across all sex and age groups. However, it should be noted that although the use of case rates in reporting injuries allows comparisons to other studies, the size of the sampled population should also be considered. Future investigations should consider a bigger sample size and more competitions to be surveyed. In general, the number and rates of injuries reported here match those available in the literature. Although most of the injuries recorded were minor, dislocation occurred three times in one competition. Even when severe injuries are rare, more attention should be given to reduce or prevent them, for they require dropping from the competition and some days off from practice. As a suggestion for future studies, there should be a more detailed look at the severe injuries occurring in judo competitions.

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