

Research article

## Injury profile in women Shotokan Karate Championships in Iran (2004-2005)

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### Abstract

The aims of this paper were to record injury rates among Iranian women competitive Shotokan karate athletes and propose possible predisposing factors. A prospective recording of the injuries resulting from all matches in 6 consecutive women national Shotokan Karate Championships in all age groups in Iran (season 2004-2005) was performed. Data recorded included demographic characteristics (Age and Weight), athletic background (rank, years of experience, time spent training and previous injuries), type, location and reason for the injury, and the result of the match. Results indicate 186 recorded injuries from a total of 1139 bouts involving 1019 athletes, therefore there were 0.163 injury per bout [C.I. 95%: 0.142-0.184] and 183 injuries per 1000 athletes [C.I. 95%: 159-205]. Injuries were most commonly located in the head and neck (55.4%) followed by the lower limb (21%), upper limb (12.9%) and trunk (10.8%). Punches (48.4%) were associated with more injuries than kicks (33.3%). The injuries consisted of muscle strain and contusion (81, 43.6%), hematoma and epistaxis (49, 26.3%), lacerations and abrasions (28, 15.1%), concussion (13, 7%), tooth avulsion or subluxation (3, 1.6%), joint dislocation (3, 1.6%) and fractures (3, 1.6%). In conclusion, as the majority of injuries are minor, and severe or longstanding injuries are uncommon, it can be argued that shotokan karate is a relatively safe for females, despite its image as a combat sport, where ostensibly the aim appears to injure your opponent. Further research is needed to evaluate the effective strategies to minimize the risk of injuries.

**Key words:** Karate, martial arts, athletic injuries, risk factors, safety, sports.

### Introduction

Participation in the martial arts has increased dramatically over the past 15 to 20 years (Oler et al., 1991; Pieter and Lufting, 1994). Karate is one of the most widespread martial arts and the Japanese word "karate", meaning empty hand (kara = empty, te = hand), describes the property of this sport involving the use of punches, kicks and blocking techniques without the use of weapons. Shotokan karate is one of the oldest styles of karate and was first publicly demonstrated in Japan in 1922 by its modern day founder Funakoshi, though it had originated from the Japanese island of Okinawa in 16th century (Stricevic et al., 1983).

Shotokan karate is among the more popular art forms, with a conservative estimate of 2 million participants worldwide (Oler et al., 1991). Shotokan karate is considered noncontact, in which punches and kicks must be controlled (without injury to the opponent) or stopped before contact with the opponent's body. Correctly executed techniques to the head or trunk are scored. For un-

controlled punches and kicks, the competitor receives a penalty and the opponent wins a point. Sparring in tournaments is often more aggressive, therefore mouth guards and lightweight sparring gloves are worn (Violan et al., 1997).

Modern non-contact karate tournament competitions consist of two disciplines: kata and kumite. Kata is a set combination of techniques which are practiced with imaginary opponents, and kumite is the term used for sparring with an opponent and ranges from prearranged moves for beginners to "free fighting" for experienced practitioners and for use in competitions (Frederic, 1995). Other benefits to competing in karate include, improved flexibility, strength, and balance (Violan et al., 1997), increases agility, and decreases reaction time (Layton 1993). It also is proposed to enhance qualities such as respect, politeness, discipline, concentration, patience, power of observation and self-confidence (Fetto, 1994; Daniels and Thornton 1990; Daniels and Thornton, 1992).

Increasing numbers of women are taking part in martial arts in order to maintain fitness and provide skills for self-defence all around the world (Zetaruk et al., 2005). In Iran, the popularity of martial arts including Shotokan karate is more evident among women, because they can join in this sport without contravening their Islamic beliefs regarding use of covered garment and scarf and so they can participate in national and sometimes international sports events.

As a martial art, Shotokan karate may be perceived as carrying a high risk of injury as the aim is to strike the opponent. Although several articles regarding karate injuries have been published, although the generalisability of findings is limited by the research design used. Studies include case reports (Arriaza et al., 1990; Ortu et al., 2006) and retrospective studies (Birrerr and Halbrook, 1988; Zetaruk et al., 2000a; Destombe et al., 2006; Tuominen 1995). Research into the injury and karate performance is relatively widespread with some studies conducted in training (Zetaruk et al., 2000b) and others in competition (Muller-Rath et al., 2000; Stricevic et al., 1983; Macan et al., 2006). Further, some studies have compared injury risk in a range of martial arts and not only karate (Birrerr, 1996; Birrerr and Halbrook, 1988) or compared the injury risk of karate with other martial arts (Zetaruk et al., 2005; Oler et al., 1991). Despite the number of studies, it is proposed a consistent pattern of results does not exist.

The aim of the present study was to document the injury rate and patterns in Iranian women competitive Shotokan karate athletes participating in 6 diverse national championship events during the season (2004-2005).

**Table 1.** General characteristics of all athletes, either injured or not.

Variable	Classification	Non-injured (N=833)		Injured (N=186)	
Age	≤ 10y	19	2.3%	7	3.8%
	11-15y	84	10.1%	19	10.2%
	16-20y	311	37.3%	78	41.9%
	21-25y	314	37.7%	69	37.1%
	26-30y	86	10.3%	12	6.5%
	≥ 31y	19	2.3%	1	0.5%
Weight	≤ 45 Kg	91	11%	17	9.1%
	46-55	305	36.6%	64	34.4%
	56-65	356	42.7%	80	43%
	≥ 66	81	9.7%	25	13.4%
Belt rank	Black	630	75.6%	152	81.7%
	Brown	196	23.5%	34	18.3%
	Purple	7	0.8%	0	0
Experience	<3y	143	17.2%	15	8.1%
	3-6y	328	39.4%	86	46.2%
	>6y	362	43.4%	85	45.7%

## Methods

We performed a prospective recording of the injuries resulting from 1139 matches and in 1019 athletes participating in 6 consecutive women national Shotokan Karate Championships in all age groups during season 2004-2005 in Iran. The Research Ethics Committee of Tehran University of Medical Sciences approved all the procedure.

We surveyed the general characteristics of all participants including age, weight, belt rank and the athletic experience were obtained from the organizing committee of the national championship tournaments, affiliated to Iranian federation of Karate. Qualified physicians staffed the tournament at the ring side were responsible for recording injuries that took place during the competition. Every injury that was seen by the tournament doctors, based on the opinion of the competitor or the referee and no matter how minor, was registered. Data were collected with check off forms consisting two sections: personal data and injury data. The personal data included the competitor's name, gender, age, category and weight, belt rank, years of experience, hours of training per week and previous injuries. The injury data included a thorough checklist of the type, localization, mechanism of injury and the result of the match at the injury time. Potential injuries grouped by body region (head and neck, trunk and groin, upper extremities, lower extremities).

Due to difficulties in assessing the long-term affects of injury due to competitors dispersing following competition, injury severity was classified into one of three grades.

- Grade 1: competitor was injured but was able to continue the competition;
- Grade 2: injuries that required withdrawal from the competition;
- Grade 3: injuries that required hospital admission.

According to localization, injuries were divided into four broad classifications: head, face and neck injuries (including nose, eyes, mouth, jaw, skull and cervical region), trunk and genitalia (abdomen, thorax, back and vulva), upper extremity (shoulder, arm, elbow, forearm, wrist, hand and fingers) and lower extremity (thigh, knee,

shin, ankle and foot) and by type, they were classified as hematoma, laceration, swelling and spasm, fracture, dislocation and concussion.

All recorded injuries were included in analysis. Main outcome measures included injury rate, body regions injured, and types of injury. Injury rate was calculated according to number of the matches and number of the athletes. The P value was set at the .05 level.

## Results

A total of 1139 bouts involving 1019 athletes occurred during the study period. Overall, 186 injuries were recorded with an injury per bout ratio of 0.163 [C.I. 95%: 0.142-0.184] and a ratio of 183 injuries per 1000 athletes [C.I. 95%: 159-205]. The demographic characteristics of the athletes (injured or non-injured) have been shown (Table 1).

Results indicated that experienced competitors (more than 3 y) were more injury-prone than less experienced ones (P= 0.002). No significant differences between injured and non-injured athletes regarding the variables such as age, weight and belt rank were found.

With regard to mechanism of injury, punches (90, 48.4%) caused more injuries than kicks (62, 33.3%). Other mechanisms such as stumble and blocking the opponent's strike accounted for the remaining 34 injuries (18.3%). The injuries were most commonly located in the head and neck followed by the lower limb, upper limb and trunk (Table 2). Figure 1 shows the distribution of injuries in a schematic karateka, as a summary.

The injuries primarily consisted of muscle strain and contusion (81, 43.6%), hematoma and epistaxis (49, 26.3%), lacerations and abrasions (28, 15.1%), concussion (13, 7%), tooth avulsion or subluxation (3, 1.6%), joint dislocation (3, 1.6%) and fractures (3, 1.6%) (Table 3). Among concussions, only one injured athlete presented with complete loss of consciousness and transferred to hospital by medical emergency. The majority of the injuries were grade 1, in which athlete was able to continue the competition after a short time of rest or medical care (149, 80.1%). Grade 2 and 3 injuries constitute the remaining cases; 27 (14.5%) and 10 (5.4%) respectively and athlete withdrew from the competition or

**Table 2.** The distribution of injuries.

Injuries		Number	Percentage
<b>Head, face and neck (103, 55.4%)</b>	Nose	54	29%
	Eyes	12	6.5%
	Mouth	13	7%
	Jaw	11	5.9%
	Skull	9	4.8%
	Cervical region	4	2.2%
<b>Trunk and genitalia (20, 10.8%)</b>	Abdomen	10	5.4%
	Thorax	5	2.7%
	Back	4	2.2%
	Vulva	1	0.5%
<b>Limbs (63, 33.9%)</b>	Upper limb	24	12.9%
	Lower limb	39	21%

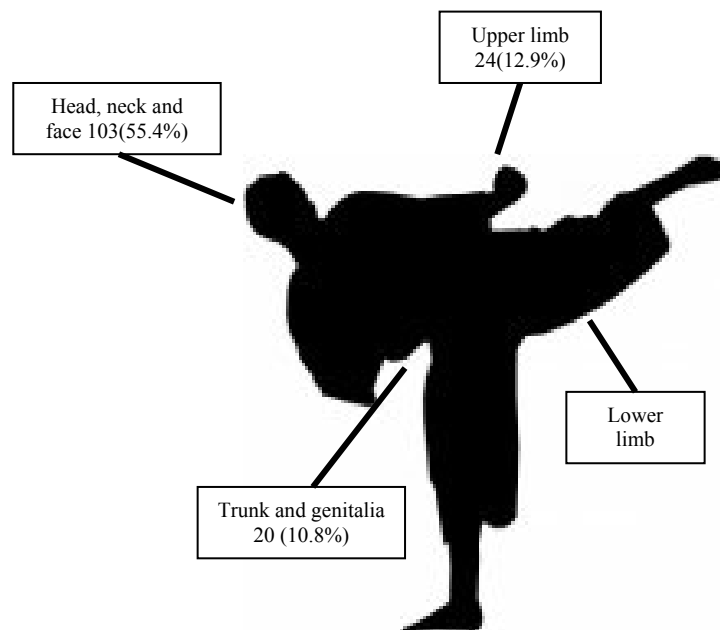
transferred to the hospital. With regards to the score of the bout at the time of injury, the injured athletes were in the winning (99, 53.2%), loss (75, 40.4%) and draw positions (12, 6.4%). There was no statistical association between the injury rate and score at the time of injury. With regard to the time of injury during the bout, each match was divided to 3 sections: first 30 seconds, middle 60 seconds and last 30 seconds. 48 (25.8%), 96(51.6%) and 42 (22.6%) injuries were recorded in these sections; respectively.

## Discussion

Several studies are comparable to our investigation, principally studies directed towards examining injuries sustained while competing (Birrer and Halbhook, 1988; Buschbacher and Shay, 1999; Johannsen and Noerregaard, 1988; Kujala et al., 1995; MacLatchie, 1981; Stricevic et al., 1983; Tenvergert et al., 1992; Tuominen, 1995; Zetaruk et al., 2000a). The rate of injuries in our study, 0.16 injuries per bout, a figure that is lower than those previously reported by Arriaza and Leyes (2005)

(0.31), Tuominen et al. (1995) (0.28), Johannsen and Noerregaard (1988) (0.26), Stricevic et al. (1983) (0.30) and more than Critchley (1999) (0.09) and compares favorably with Zetaruk et al (2005) (17%) and McLatchie (1977) (0.20). This may be due to the different level or style of competitions (sparring vs. non-contact) in these studies. Injury rates from martial arts tournaments which are not of the light contact form tend to be much higher. For example, McLatchie (1977) found a far higher rate of 53/100 but studied only participants in aggressive full-contact knock-down championships.

Although martial arts have a reputation for being a high risk sport, many authors do not support this belief. Tenvergert et al. (1992) studied injuries associated with four sports over a 7-year period. The annual injury rates in martial arts were lower than soccer, volleyball and gymnastics. The injury pattern in our study compares relatively to earlier studies (Arriaza and Leyes 2005; Birrer 1988; 1996; Critchley et al 1999; Muller-Rath et al., 2000; Stricevic et al., 1983; Tuominen, 1995; Zetaruk et al 2000a) in which hematomas, contusions and strains have been reported as the most frequent injuries.

**Figure 1.** Distribution of injuries in a schematic karateka.

**Table 3. Type of injuries.**

Injury type	Number	Percentage
Muscle strain and contusion	81	43.6%
Hematoma/ bleeding/ epistaxis	49	26.3%
Abrasion/ laceration	28	15.1%
Concussion	13	7%
Tooth avulsion/subluxation	3	1.6%
Fracture	3	1.6%
Dislocations	3	1.6%

Muscle strains and contusions were the most frequent types of injury in our study (43.6%). These lesions are often due the result of ballistic movements such as kicking, particularly if there has not been an adequate warm-up. The coaches clearly have a key role to insist on proper and full warm-up routines. We also found a high incidence of hemorrhage (49, 26.3%) or once in every 23 bouts which is lower than one in every ten matches reported by Arriaza and Leyes (2005). This high incidence represents the risk of blood-borne pathogen transmission. Therefore, special cautions should be applied by attending physicians to minimize the risk.

The nose is the most common site of hematomas. Other common hematoma sites are the forearm, which is widely used for the blocks, and the dorsum of the foot, which is exposed during kicks and blocks. In our study, we recorded 3 dental avulsions (1.6%), which corresponds well with Arriaza and Leyes (2005) who reported dental avulsions and teeth fractures in 1.4% of injuries. These figures have reported to be higher in previous tournaments (Kujala et al., 1995). Since 1994, the use of mouth-guards is compulsory in karate competitions and it has decreased the incidence and severity of dental injuries.

One of the most clinically important findings of this study is the higher rate of concussion (13, 7%) when compared with the studies conducted by McLatchie et al (1977) (3%), Buschbacher (1999) (3%) and Arriaza and Leyes (2005) (3.8%). It may be partly explained by the fact that the Iranian coaches promote the use of high kick techniques in athletes, because they regard these techniques as aesthetical ones with resultant full scores. As a result, if the athlete performs the techniques properly, there will be a considerable risk for the opponent to be injured by a heavy strike. On the other hand, because of the less controllable and risky nature of these kicks, the athlete may fall on her back and injured herself as head trauma and concussion. Nevertheless, the complete loss of consciousness was reported only in one competitor, who on being transported to hospital and discharged one day later, with no apparent consequence. As concussion may be a serious and potentially fatal injury, it seems that a particular emphasis should be placed on education and control by competitors and referees to reduce the contact to the head and neck region in Shotokan karate.

With regard to the localization of injuries, head and face represent the highest percentage of injuries (55.4%), although the relative frequency is lower than what reported by some authors such as Arriaza and Leyes (2005) (84.1%) and Tuominen (1995) (97%).

In our study, lower limb injuries (21% of all injuries) were more frequent than some other studies by Arri-

aza and Leyes (2005), Johannsen and Noerregaard (1988) and MacLatchie (1977) who report lower frequencies; 6.4%, 4% and 9%, respectively. It may be explained by the new changes in scoring rules, which reward leg techniques more than before and therefore make them more popular among athletes. Leg injuries mostly occur during contact of the instep or shin with the opponent's elbow, hip, or forearm. The leg is also often injured when both opponents perform a leg maneuver at the same time.

Concerning injury severity, the rate of severe injury (grade 3) was 8.8 per 1000 bouts (9.8 per 1000 athletes). This rate is lower than the ones reported in other sports such as taekwondo (23–33.5), soccer (16.6–23.1), amateur boxing (47.5) (Kujala et al., 1995; Plancher and Minnich, 1996), aikido (28%) and kung fu (18%) (Zetarak et al., 2005). However, the definition and classification of severity may differ between studies and therefore making meaningful comparisons is difficult.

With regard to mechanism of injury, punches were associated with more injuries (48.4%) than kicks (33.3%). Other mechanisms such as stumble and blocking the opponent's strike accounted for the remaining 18.3%. At the first glance, it seems that punches have a higher injury ratio than kicks (around 1.5 to 1), but as the number of punches in a karate contest is much higher than the number of kicks (with a ratio of approximately 10 to 1), the inverse conclusion would be more reasonable.

We found that injuries were more common among experienced athletes and the risk of injury increases with number of years of training. It is not surprising that such a relationship exists when one considers that speed, force of techniques, and confidence all increase with experience. This potentially leads to more aggressive style, placing the more experienced karateka at increased risk of injury.

With regard to the time of injury during the bout, although we expected to record more injuries in the last 30 seconds of the bout, due to maximal tension and stress as well as fatigue in this time, no significant difference was found. Furthermore, there was no statistical correlation between the occurrence of injury and score at the time of injury. Because these topics have been first proposed as potential risk factors in this study, it should be addressed in future studies to compare the results.

Our results support that the attendance of a qualified physician in a karate competition is essential. In our study, interventions were called up approximately in one in every 6 matches. However, some of these requests for medical interventions are not for real injury. Several factors have been recognized for injury prevention. The most important factors in decreasing the injury rate has been the enthusiasm of the referees to stop play that is dangerously violent, and penalize competitors who participate

without proper regard for safety. It is proposed that the outlawing of particular uncontrollable methods of attack and having referees apply the already existing rules for competition strictly would reduce injury risk to athletes. Furthermore, attendance of medical personnel is a necessity, not only to manage injuries but also identify predisposing factors to the injury. In addition, we argue that injury risk would be reduced by factors including a) careful teaching, and b) close monitoring by coaches to ensure faultless control of each strike. Routine warm-up exercises before each session, the use of protective pads and gear and padded flooring may also have preventive roles. Provided these guidelines are followed, Shotokan karate would be a suitable and low risk sport for female participants.

There were some limitations to our prospective study. First, it was very difficult for us to identify the precise duration of the matches: each karate bout lasts 2 min in competitions for females, but some may finish before time due to disqualification, severe injury or scoring full points, and others may have gone on to an extra time to decide the winner if two athletes draw at the end of the usual time. Therefore, we could not carry out an accurate calculation of the injury rate per minute of exposure. However, the statistical data of the number of injuries per 1,000 bouts (athlete exposures) and per 1,000 athletes permits us to compare karate statistics with other sports disciplines.

Other limitations of the study relate to our definition of injury. Because we define injury based on the request of competitor or referee for medical intervention, we may incorrectly consider injury in an athlete who may simulate in an attempt to achieve time for recuperation or cause the score penalty of the opponent by referee. On the other side, we may overlook injuries in athletes who do not seek medical intervention due to their excessive motivation to terminate the bouts. A further drawback was the difficulty of knowing the exact severity of some injuries that could only be determined after comprehensive examination once the athlete returns home.

## Conclusion

In this study 186 injuries from a total of 1139 bouts were recorded, involving 1019 athletes. Therefore, there were 0.163 injury per bout [C.I. 95%: 0.142-0.184] and 183 injuries per 1000 athletes [C.I. 95%: 159-205]. Injuries were most commonly located in the head and neck (55.4%) followed by the lower limb (21%), upper limb (12.9%) and trunk (10.8%). The injuries consisted of muscle strain and contusion, hematoma and epistaxis, lacerations and abrasions, concussion, tooth avulsion or subluxation, joint dislocation and fractures. The majority of injuries are minor and low grade, and severe or long-standing injuries are really uncommon. So, it can be claimed that Shotokan karate is a relatively safe for females, despite its image as a combat martial sport. It is proposed that this study offers a baseline for further studies and comparison of the injury characteristics in Shotokan karate competitions. Further research is needed to evaluate the effective strategies to minimize the risk of injuries. Moreover, it is recommended that future studies

be conducted to examine the relationship between injury rate and potential risk factors such as athletes' lack of physical fitness, insufficient technical expertise, psychological and behavioral disorders in addition to the variables used in this study. Although descriptive research should continue, analytical studies are considerably needed.

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### Key points

- 186 injuries were recorded during women competitions.
- Incidence rates of 0.163 injury per bout and 183 injuries per 1000 athletes were calculated.
- The injuries were most commonly located in the head and neck.
- Muscle strain and contusion, hematoma and epistaxis constitute the majority of injuries.

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