

TRAUMATOLOGY

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Sport injuries in Portuguese female and male *karateka*: a retrospective study

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Abstract

Background. Karate is a combat sport in which, as in all sports, there are risk factors that lead to injuries to its practitioners.

Problem and Aim. Little is known about injuries in Portuguese *karateka*. Thus, the purpose of this study was to investigate the type and incidence of injury in both female and male Portuguese karate practitioners.

Material and Methods. The sample was composed of 490 karate practitioners from nine different karate styles, 105 females and 385 males. In this retrospective study a questionnaire of morbidity was applied, in which participants recorded their demographic data and injury episodes occurring in the last three sports seasons.

Results. Of the full sample, 51.8% ($n=254$) reported one or more injuries. No statistical differences were found between the sexes. Most frequent injuries were fractures (16.1%) and trauma (15.6%) in both sexes and occurred in the lower limb (64.3% in females and 52.0% in males). The mechanism responsible for most of injuries in females were falls (12.5%), while in males it was punch actions (10.3%). Injuries were reported as moderate to severe, causing inactivity of practice of between 8 and 21 days and higher, respectively. Most injuries occurred in the preparatory period (63.6% females, males 53.2%), and mainly occurred in training (85.5% in females and 84.5% in males).
Conclusions. Coaches should analyse the specificity of the gender training process to prevent the appearance of injuries, and increase the use of preventive processes, such as the use of protection or practice in place, and with safe equipment.

Introduction

Karate is a combat sport in which, as in all sports, there are risk factors that lead to injuries to its practitioners. With the increasing number of karate practitioners around the world, the number of women practitioners has also increased, but they are exposed to the same risk factors of injury of this sport as men.

In general, practitioners seek this sport to maintain fitness and provide self-defence skills, but the practice of karate also provides benefits in the development of

flexibility, strength, speed, motor coordination, balance and on factors related to socialization as respect and discipline [Zetaruk *et al.* 2005]. Nevertheless, the risk of injury exists and is expected.

Recently, knowledge about karate injuries has been well documented [Sterkowicz, Sterkowicz-Przybycien 2013; Thomas, Ornstein 2018]. According to Ristolainen *et al.* [2009], injury patterns in athletes have been assumed to be more sport-specific than gender-specific. Research on gender differences in injuries in karate practitioners is limited. It is not well known whether

the injuries found in karate are only sport-specific and therefore related to bouts and training behaviours, or whether there are differences in injuries and risks related to gender differences.

Shotorbani *et al.* [2012] studying the prevalence of injuries in elite female karateka, found an average of 47.5 injuries per athlete per year and the highest rates of sport injuries were related to the lower limb. However, Boostani *et al.* [2012] report that in competition, each athlete of the Iran karate team has a risk of 0.32 injuries, a bit higher than that found by Critchley, Mannion, Meredith [1999] who report a rate of 0.13 per competitor. In those studies, the head and neck were the area of the body that suffers the most injuries.

Another study in the karate championships in Iran with female karatekas [Ziaee, Lotfian 2007], also report that head and neck were the most commonly injured areas followed by the lower limb, and that punches were the main mechanism, mainly causing muscle strain and contusion of lower severity.

It has been reported a rate of injury per athlete of 16.1% and an incidence rate of injury per 100 athletes of 20.2 during training [Ziaee *et al.* 2015]. Those authors found that 90% of injuries occurred during the practice of fighting, the most experienced individuals had fewer injuries, and the most prevalent injury locations were head and neck, followed by the trunk and lower limbs, with lower severity and the most common type of injury were contusion and muscle strain.

Factors such as age, training volume and body mass index were found as significant predictors of injury [Vitale *et al.* 2018]. Changes in the rules of competition have been important to reduce the risk of injury [Macan, Bundalo-Vrbanac, Romić 2006; Arriaza *et al.* 2009].

The risk of injury should be a concern during training and competition, as well as the repercussions that they have on regular or competitive karate practitioners. Therefore, this retrospective study was performed with the purpose of analysing the type and incidence of injury in Portuguese female and male karate practitioners and comparing them trying to understand if there are gender-related differences.

Material and Methods

Participants

This study was conducted according to the Helsinki Declaration and was approved by the scientific committee of the Sports Sciences School of Rio Maior, Polytechnic Institute of Santarém, Portugal. All the participants in this study were informed about procedures and signed an informed consent form.

The sample consisted of 490 karate practitioners from nine different karate styles, 21.6% females ($n=105$) and 78.4% males ($n=385$). 25.5% had a Kyu level ($n=125$),

of which 29.6% were females ($n=37$), and 74.5% had Dan graduation ($n=365$), of which 18.6% were females ($n=68$).

Of the full sample, 254 karate practitioners reported injuries. Table 1 shows the demographic characteristics of karatekas who reported injuries.

Table 1. Demographic characterization of male and female karate practitioners who reported injuries.

Variable	FeK ($n=56$)	MaK ($n=198$)	<i>p</i>
Age (years)	25.1 ± 10.12	33.6 ± 13.22	<0.001
Height (cm)	163.0 ± 0.07	174.7 ± 0.07	<0.001
Weight (kg)	57.4 ± 9.44	75.5 ± 11.73	<0.001
BMI (kg/m ²)	21.6 ± 2.98	24.7 ± 3.35	<0.001
Weekly training (h)	5.4 ± 3	5.4 ± 3	NS
Training practice (years)	14.2 ± 7.16	16.5 ± 8.52	NS

Values are mean ± SD. ANOVA *P* values are shown. FeK, female karate practitioners; MaK, male karate practitioners; cm, centimeter; m, meter; kg, kilogram; h, hour. NS, not significant.

Data collection procedures

In this retrospective study a questionnaire of “morbidity” was applied [De Loes, Goldie 1988; Pastre *et al.* 2004], in which karate practitioners recorded their demographic data and injury episodes occurred in the last three sport seasons. The questionnaire had two parts. The first inquired about personal information of each athlete. The second part addressed the injury episodes in six dimensions of analysis (type, anatomical location, mechanism, severity, time of occurrence in the sport season and type of activity).

The term injury was defined as the one that occurs suddenly or accidentally, requiring any time off from training or competition [Zetaruk *et al.* 2005]. Any injury that required 1 to 7 days of inactivity was classified as low severity, 8 to 21 days as moderate severity and more than 21 days as severe.

The time of occurrence of the injury in the sport season refers to the preparatory, competitive or transitory period, while the type of activity refers to training or competition (divided into combat or technical).

Statistics

Statistical analysis was conducted using SPSS version 20 (SPSS Inc, USA). Descriptive statistics were expressed as frequencies and percentages or arithmetic means and standard deviations. Comparisons between two groups were made using independent samples *t*-test after checking for data normality and homogeneity of variances. Comparisons between two qualitative variables were made using Chi-square tests. Fisher’s exact test was used whenever the conditions to apply Chi-square were not present. Cramer’s V was used to check for association between two categorical variables. Statistical significance level was set at $p? 0.05$.

Results

Out of all the participants in the study, 51.8% ($n=254$) reported one or more injuries. The data in the Table 2 shows the number of injuries of female and male karate practitioners. In this variable dimension no statistical differences were found between the sexes ($p=0.803$), however it was verified that female karate practitioners presented a slightly higher percentage of injuries (53.3%) compared to males (51.4%), with a tendency for a higher percentage of second injury.

Table 2. Number of injuries.

Number of injuries	FeK	MaK
No injury	49 (46.7%)	187 (48.6%)
1 Injury	30 (28.6%)	123 (31.9%)
2 Injuries or more	26 (24.8%)	75 (19.5%)
Total of injuries	56 (53.3%)	198 (51.4%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

Table 3 presents the type of injuries reported by female and male karate practitioners. No statistical differences were found between the sexes ($p=0.265$), nevertheless women presented a higher frequency of injuries as fracture (16.1%), sprain (14.3%) and rupture (14.3%), while in man were trauma (15.6%), rupture (13.8%) and sprain (12.4%) the most frequent injuries.

Table 3. Type of injuries.

Type of injuries	FeK	MaK
Trauma	5 (8.9%)	34 (15.6%)
Muscle strain	7 (12.5%)	12 (5.5%)
Contracture	2 (3.6%)	13 (6.0%)
Tendinitis	4 (7.1%)	12 (5.5%)
Sprain	8 (14.3%)	27 (12.4%)
Myalgia	0 (0.0%)	2 (0.9%)
Bursitis	0 (0.0%)	8 (3.7%)
Fracture	9 (16.1%)	25 (11.5%)
Rupture	8 (14.3%)	30 (13.8%)
Dislocation	3 (5.4%)	23 (10.6%)
Acute pain	3 (5.4%)	20 (9.2%)
Chronic pain	7 (12.5%)	12 (5.5%)
Total	56 (100%)	218 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

According to the anatomical location of injury (Table 4), no statistical differences were found between both sexes ($p=0.355$), but most of the injuries occurred with a higher frequency in the lower limb in females (64.3%) and males (52.0%), followed by upper limb, 19.6% and 29.6%, and trunk, 16.1% and 14.3%, respectively. Only 3 injuries occurred in the head in male karatekas (1.5%). The most frequent injuries were similar in both sexes, where females reported 25.0% of injuries

in the knee, 14.3% in the ankle and 14.3% in the hand, while in males 18.4% occurred in the knee, 13.3% in the foot and 12.2% in the hand.

Table 4. Anatomical location of injury.

Anatomical location of injury	FeK	MaK
Head	0 (0.0%)	3 (1.5%)
Thorax	1 (1.8%)	4 (2.0%)
Cervical region	3 (5.4%)	7 (3.6%)
Lumbar region	5 (8.9%)	17 (8.7%)
Shoulder girdle	0 (0.0%)	21 (10.7%)
Arm	0 (0.0%)	0 (0.0%)
Elbow	0 (0.0%)	3 (1.5%)
Forearm	0 (0.0%)	3 (1.5%)
Fist	3 (5.4%)	7 (3.6%)
Hand	8 (14.3%)	24 (12.2%)
Pelvic girdle	0 (0.0%)	4 (2.0%)
Groin	2 (3.6%)	6 (3.1%)
Thigh	5 (8.9%)	13 (6.6%)
Knee	14 (25.0%)	36 (18.4%)
Leg	3 (5.4%)	9 (4.6%)
Ankle	8 (14.3%)	8 (4.1%)
Foot	4 (7.1%)	26 (13.3%)
Others	0 (0.0%)	5 (2.6%)
Total	56 (100%)	196 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

Table 5 shows the mechanism of injuries reported by female and male karate practitioners. In this variable dimension no statistical differences were found between both sexes ($p=0.506$), however the mechanism of injury responsible for most of injuries in females were falls (12.5%), explosion (10.7%) and jump and punch (8.9%), while in males it was punch (10.3%) and kick actions (9.9%), and explosion and contact on the opponent (8.2%).

Table 5. Mechanism of injury.

Mechanism of injury	FeK	MaK
Velocity	2 (3.6%)	11 (4.7%)
Explosion	6 (10.7%)	19 (8.2%)
Resistance	2 (3.6%)	11 (4.7%)
Flexibility	4 (7.1%)	13 (5.6%)
Defence	3 (5.4%)	15 (6.5%)
Falls	7 (12.5%)	15 (6.5%)
Jump	5 (8.9%)	11 (4.7%)
Spin	2 (3.6%)	17 (7.3%)
Kick	3 (5.4%)	23 (9.9%)
Punch	5 (8.9%)	24 (10.3%)
Projection	3 (5.4%)	14 (6.0%)
Contact on target	0 (0.0%)	7 (3.0%)
Contact on opponent	1 (1.8%)	19 (8.2%)
Others	13 (23.2%)	33 (14.2%)
Total	56 (100%)	232 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

Table 6 presents the severity of injuries, where no statistical differences were found between both sexes ($p=0.547$). Injuries were reported as having a moderated severity, 36.4% in females and 42.2% in males, causing inactivity of practice between 8 and 21 days, nevertheless 47.3% of injuries in females and 39.7% in males were severe, causing inactivity of practice higher than 21 days.

Table 6. Severity of injury.

Severity of injury	FeK	MaK
Low (1-7 days)	9 (16.4%)	36 (18.1%)
Moderate (8-21 days)	20 (36.4%)	84 (42.2%)
Severe (>21 days)	26 (47.3%)	79 (39.7%)
Total	55 (100%)	199 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

According to the time of occurrence of injuries in the sport season (Table 7), no statistical differences were found between both sexes ($p=0.183$), however the data shows that was in the preparatory period that most of injuries occurred in females (63.6%) and males (53.2%), followed by competitive period, 27.3% and 29.4%, and transitory period, 9.1% and 17.5%, respectively.

Table 7. Time of occurrence of injuries on the sport season.

Time of occurrence of injuries	FeK	MaK
Preparatory period	21 (63.6%)	67 (53.2%)
Competitive period	9 (27.3%)	37 (29.4%)
Transitory period	3 (9.1%)	22 (17.5%)
Total	33 (100%)	126 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

Table 8 presents the type of activity responsible for the injuries. In this variable dimension no statistic differences were found between the sexes ($p=0.332$), nevertheless it was verified that mainly the injuries occurred in training, 85.5% in females and 84.5% in males, followed by combat competition, 10.9% and 14.4%, respectively. Kata competitions represent low risk of injury.

Table 8. Type of activity.

Type of activity	FeK	MaK
Training	47 (85.5%)	164 (84.5%)
Combat competition	6 (10.9%)	28 (14.4%)
Technical competition (Kata)	2 (3.6%)	2 (1.0%)
Total	55 (100%)	194 (100%)

Values are frequency (percentage). FeK, female karate practitioners; MaK, male karate practitioners.

Discussion

Similar injury rates have been observed between both sexes, although female karate practitioners presented a higher percentage of second type injury. The weekly hours of training were also similar between both sexes, showing that females were not at a higher risk of incurring an injury than males. This evidence was also reported in young boys and girls karate athletes [Pieter 2010] and in young and seniors of both sexes [Macan, Bundalo, Romić 2001].

The most frequent type of injuries reported by female karate practitioners were fracture, sprain and rupture, while in male karate practitioners these were trauma, rupture and sprain. In the study of Pappas [2007], it has been reported contusion and abrasions (23.2%), fractures (24.3%), and strains and sprains (31%) were the most frequent type of injuries. Boostani *et al.* [2011] found that muscular trauma was the most frequent type of injury (38.4%), followed by muscular contusion (15.1%) and strain (7.5%) and dislocation (7.5%). Ziaee *et al.* [2015] found that contusion, redness, bruise, superficial scratch were the more common injuries (64%), followed by superficial wound, deep wound and bleeding (24.8) and luxation, tendon stretching and fracture (11.2%). In females [Halabchi, Ziaee, Lotfian 2007], the most frequent injuries were muscle strain and contusion (43.6%), hematoma, bleeding and epistaxis (26.3%), and abrasion and laceration (15.1%). In children and adolescents, the most frequent injuries were bruises or contusions [Zetaruk *et al.*, 2000; Pieter, 2010; Cierna, Lystad 2017], and has been reported low injury rates in top-level karate competition for young adolescents [Arriaza *et al.* 2016]. Some authors [Kujala *et al.* 1995; McPherson, Pickett 2010] found that fractures were the most common type of injuries in karate, while Rahimi *et al.* [2012] reported contusion (60%).

According to the anatomical locations of injury, we have found that most of injuries occurred in the lower limb in both sexes, followed by upper limb, trunk and head. These results are consistent with those of Zetaruk *et al.* [2005], although most of studies in the literature report head and neck as the most frequent injury location [Critchley, Mannion, Meredith, 1999; Macan, Bundalo, Romić 2001; Arriaza, Leyes, 2005; Pieter, 2005, 2010; Halabchi, Ziaee, Lotfian 2007; Ghasemi *et al.* 2010; Boostani *et al.* 2011; Peeri *et al.* 2011; Alizadeh, Shirzad, Sedaghati 2012; Rahimi *et al.* 2012; Ziaee *et al.* 2015; Cierna, Lystad 2017]. The high incidence of injuries in the head referred by those studies does not occur in Portuguese karate practitioners. This fact should be associated with different methodologies and objectives of training and perhaps a less aggressive practice of karate in Portugal with a different preparation of the karatekas. Souza *et al.* [2011], in Brazilian karate practitioners, found that the most injury locations were upper and lower extremities,

namely the hands (15.5%), foot (12.8%) and leg (9.5%). Tischer *et al.* [2016], reported that recurrent medical treatment was more frequent in the knee, ankle and hand and foot in Kumite athletes, while knee, shoulder and hand and foot in Kata athletes. The lower and upper extremities have also been reported as the major anatomical locations of injury [Zetaruk *et al.* 2000; Pappas 2007; McPherson, Pickett 2010; Ambrozy *et al.* 2015].

The main mechanism of injury reported by females were falls, explosion, jump and punch actions, while in males were punch and kick actions, and explosion and contact on the opponent. Grouping the mechanisms by category, it is possible to verify that technical gestures were responsible for 50.0% of injuries in females and 51.3% in males, physical preparation for 25.0 and 23.3%, contact for 1.8 and 11.2% and other factors for 23.2% and 14.2%, respectively. McPherson and Pickett [2010] reported that the main mechanism of injury was the kick/foot strike (38%), followed by fall/throw/jump (26%), punch/hand strike (10%) and block (9%), and that 55% of the total injuries were inflicted by another participant. It has been reported that punch [Stricevic *et al.* 1983; Macan, Bundalo, Romić 2001; Pieter 2005, 2010; Halabchi, Ziaee, Lotfian 2007] and kick [Ambrozy *et al.* 2015] as the most mechanism of injury. Boostani *et al.* [2011] found that most important mechanism of injury was related to opponents kick and punch blows (56.9%), following by athletes kicks and punches (33.3%) and falls (9.8%).

Regarding the severity of injuries, the results showed that it is moderate, causing inactivity of practice between 8 and 21 days, and severe, causing inactivity of practice to exceed 21 days. These results were important, since in about 47% of the injuries in females and 40% of the injuries in males were severe, causing inactivity of the practice of karate superior to 21 days. McPherson and Pickett [2010] found that 25% of injuries were severe. Some authors found that injuries were of low severity in karate competition [Macan, Bundalo, Romić 2001; Macan, Bundalo-Vrbanac, Romić 2006; Arriaza *et al.* 2009; Rahimi *et al.* 2012] and training [Ziaee *et al.* 2015].

Injuries occur mostly during the preparatory period, which corresponds to the general preparation of the Portuguese karatekas, followed by the competitive period. To our knowledge, there are no data available in karate athletes. Notwithstanding the fact that the preparatory period has an increase in volume of training, after a rest period, which can lead to a higher incidence of injuries. It has been reported that players were 50-80% likely to sustain a preseason injury [Gabbett 2010]. In addition, excessive and rapid increases in training loads are possibly responsible for a large proportion of non-contact, soft-tissue injuries [Gabbett 2016].

A relevant finding of this study is that injuries occurred mainly during training of this sport (in about 85% in both sexes). Similar results were found by sev-

eral authors [Kujala *et al.* 1995; Greier, Riechelmann, Ziemska 2014; Ambrozy *et al.* 2015]. Although, lower percentages were found in the study by Shotorbani *et al.* [2012], analysing female karate athletes, reported that 55.3% of injuries occurred in training, and Destombe *et al.* [2006] reported that only 28.8% of injuries occurred in training. If the injuries occur predominantly in training, under the guidance or supervision of the coaches, what can they do to avoid the occurrence of injuries? The Portuguese trainers are responsible for the safety in the karate practice inside the Dojo, so they must be aware of all the factors that involve the karate training, according to different populations of karateka and their objectives of practice. This will allow a better and safer karate training.

The karate practice in Portugal, like in any part of the world, has an associated risk of injury to their practitioners, but it seems that this risk is inferior to those referred in other countries, in training or in competition. However, we must consider that research methodologies between the studies were different, which causes constraints to the comparisons of results. In addition, the social environment of the populations studied may cause some differences in the karate practice. One limitation of this study is the fact that the participants may have omitted or forgotten about some injuries, specially the less severe, since they had reported the injuries in the last 3 years.

The anatomical location of the injuries, the moments of occurrence and their severity could be associated with a poor physical preparation to respond with safety when performing karate skills, especially in the situation of kumite. Reduced flexibility, explosive force, velocity and control training are some of the reasons that could limit and make unsafe the karate practice and some of those could justify the typology of injuries in the Portuguese karateka.

Conclusion

Results show similar injury rates between sexes, however, the existence of more than one episode of injury in female karate practitioners is more common. Injuries occur with greater incidence in the segmental extremities, nonetheless those that are referred to as requiring a longer stopping time occur in the trunk. It is mainly in the preparatory period and in training that female and male karateka are injured. The most common type of injuries was fracture in females and trauma in males, and the mechanism were falls and technical gestures, respectively. Injuries suffered by the karateka were of moderate to severe, causing time lost from practice between 8 and 21 days and higher, respectively.

Coaches should analyse the specificity of gender training process to prevent the appearance of injuries, increasing the use of preventive processes, such as the

use of protections or practice in places and with safe equipment.

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Urazy sportowe występujące u portugalskich kobiet i mężczyzn trenujących karate: badanie retrospektywne

Tło. Karate jest sportem walki, w którym, jak we wszystkich dyscyplinach sportowych, istnieją czynniki ryzyka, które prowadzą do urazów u ćwiczących.

Problem i cel. Niewiele wiadomo o urazach występujących u portugalskich karatek. Stąd celem niniejszego badania było zbadanie rodzaju i częstości występowania urazów zarówno u kobiet, jak i u mężczyzn trenujących karate.

Materiał i metody. Próba reprezentatywna składała się z 490 karatek, w tym 105 kobiet i 385 mężczyzn, trenujących dziewięć różnych stylów karate. W tym retrospektywnym badaniu zastosowano kwestionariusz dotyczący zachorowalności, w którym uczestnicy zapisywali dane demograficzne i dotyczące urazów, które miały miejsce w ostatnich trzech sezonach sportowych.

Wyniki. Z pośród wszystkich uczestników badania 51,8% (n=254) zgłosiło jeden lub więcej urazów. Nie stwierdzono różnic statystycznych pomiędzy płciami. U obu płci najczęściej występowały złamania (16,1%) i urazy (15,6%) kończyn dolnych (64,3% u kobiet i 52,0% u mężczyzn). Mechanizmem odpowiedzialnym za większość urazów u kobiet były upadki (12,5%), natomiast u mężczyzn kontuzje były wynikiem uderzenia (10,3%). Urazy zgłaszano jako umiarkowane do ciężkich, powodując brak aktywności zawodowej o długości od 8 do 21 dni i więcej. Większość urazów miała miejsce w okresie przygotowawczym (63,6% kobiet, 53,2% mężczyzn), głównie w czasie treningu (85,5% u kobiet i 84,5% u mężczyzn).

Wnioski. Trenerzy powinni przeanalizować specyfikę procesu treningu biorąc pod uwagę płeć zawodników, aby zapobiec pojawieniu się urazów i zwiększyć wykorzystanie procesów prewencyjnych, takich jak stosowanie ochrony lub trenowanie w odpowiednim miejscu i przy użyciu bezpiecznego sprzętu.