

# THE PREVALANCE AND DISTRIBUTION OF INJURIES IN KARATE (KUMITE)

Jelena Macan<sup>1</sup>, Danijela Bundalo<sup>2</sup> and Goran Romić<sup>3</sup>

<sup>1</sup>*Institute for Medical Research and Occupational Health, Zagreb, Croatia*

<sup>2</sup>*Medical Board of Croatian karate union, Zagreb, Croatia*

<sup>3</sup>*Karate club "Croatia", Zagreb, Croatia*

## Abstract:

The aim of this study was to establish the prevalence, distribution and severity of injuries occurring during the official karate (kumite) competitions in Croatia. The study was performed separately in women and men, in three age groups: pupils-younger cadets (10-14 years), cadets-juniors (15-21 years) and seniors (18 years). Age, gender, localisation, severity and cause of injury were recorded by means of a simple questionnaire. Non-parametric tests were used to determine the differences in prevalences and distribution of the injuries according to age and gender. Value  $P \leq 0.05$  was considered statistically significant.

In 880 fights, 206 injuries were recorded. The prevalence of injuries in male pupils –younger cadets was significantly lower than in male cadets-juniors (17.1%: 27.0%;  $P=0.042$ ) and male seniors (17.1%: 26.7%;  $P=0.023$ ). In women, the prevalence of injuries was similar in seniors, cadets-juniors and pupils-younger cadets (21.8%: 21,1%:20.7%; n.s.). There are no significant differences in the prevalence of injuries between women and men in all the studied age groups. The majority of injuries in all age groups were caused by receiving a punch. Kicks as a cause of injury were more frequent in pupils-younger cadets than in seniors (29%:11.9%;  $P=0.038$ ). The most frequent localisation of injuries was the head. Lower extremities and trunk were affected more in pupils-younger cadets than in seniors (trunk – 21.9%:5.3%; lower extremities – 21.9%:4.4%). Ninety-seven percent of injuries were categorized as minor i.e. grade 1.

The results of this study show the frequency of one injury in every four karate fights, similarly in women and men, seniors and cadets-juniors. The majority of injuries were categorized as grade 1, allowing the competitor to continue with the competition. It can be concluded that karate in Croatia is a safe sport on condition that optimal training principles and competition conditions are insured.

**Key words:** *injuries, karate, prevention*

## INTRODUCTION

Karate, a traditional martial art from China, has become very popular as a competitive and recreational sport and a method of self-defence all around the world in the last 30 years (Stričević

et al., 1990.; Stričević et al., 1983.). It involves many different karate schools (Shoto-kan, Goju-ryu, Wado-ryu, Sankukai, Shito-ryu, Kyokushinkai). The Croatian karate union has been a member of the European karate union (EKU) and the World Union of Karate-do

Organizations (WUKO) since 1992 (Sabolić, 1994.) and competitions in karate sport are carried out according to the WUKO rules. Modern karate tournament competitions consist of two disciplines: kata and kumite. Kata means fights with imaginary opponents constructed of specific sequences of basic, intermediate or advanced techniques which are meant to be performed with technical accuracy. Kumite is a synonym for karate fight (Frederic, 1995.). In karate fight punches or kicks must be controlled (without injury to the opponent) or stopped prior to contact with the opponent's body. Correctly executed techniques of blows to the head or trunk are scored. For uncontrolled punches or kicks the competitor receives a penalty and the opponent wins the point. In the last 10 years, modern karate has become one of the most popular sports in Croatia, involving a great number of children and adolescents and is also one of the sports with a high number of trophies awarded.

The aim of this study was to establish the prevalence, distribution and severity of injuries occurring during the official karate (kumite) competitions in Croatia according to different age groups and gender.

## METHODS

Data were collected during 1997, at official regional and national Croatian championships in karate fights for all age groups and at the official national elective tournament for the senior world championship. The competitions were carried out according to the WUKO rules (Sudačka komisija Hrvatskog karate saveza, 1994). A single fight lasted 3 minutes actively for seniors, 2 minutes actively for cadets and juniors and one minute actively for pupils. Competitors were required to wear gloves, gum-shields, protective supports for men and breast pads for women. Competitions were performed on a floor padded with a special hard 8 x 8 m. mat called "tatami".

Competitors were divided into three age groups:

1. pupils-younger cadets aged 10-14 years;
2. cadets-juniors aged 15-21 years;
3. seniors aged 18 years.

A total of 880 karate fights were attended by the authors. **Table 1** shows the distribution of the fights attended according to the age and gender of the competitors.

The authors used a simple questionnaire to collect the data on injuries. The data consisted of age and gender of the competitor, localisation, severity and the cause of injury. Each injury that required medical attention during the competition based on the opinion of the competitor or the judge was recorded.

Regarding the severity, the injuries were divided into three grades:

1. grade 1 – competitor was injured but was able to continue with the competition;
2. grade 2 – injuries that required withdrawal from the competition and special medical examination and treatment;
3. grade 3 – injuries that required hospitalization.

Regarding the localisation the injuries were divided into: injuries of the head, neck, trunk (including genital parts), upper and lower extremities. The cause of injury (punch or kick) was also recorded.

Statistical analysis was done by programme Statistica 5.0 with methods of descriptive statistics and non-parametric procedure (chi-square test) for testing the differences in the prevalence and distribution of injuries according to age and gender. A value of  $P \leq 0.05$  was considered statistically significant.

**Table 1.:** *The distribution of fights attended according to age and gender of competitors.*

Number of fights	Seniors	Cadets-juniors	Pupils-younger cadets	Total
Women	142	109	29	280
Men	311	137	152	600
<b>Total</b>	<b>453</b>	<b>246</b>	<b>181</b>	<b>880</b>

## RESULTS

The prevalence of injuries was analysed according to the number of attended karate fights, age and gender of competitors as well as the cause, localisation and severity of the injury.

In a total of 880 fights, 206 injuries were recorded. The prevalence according to age and gender is shown in **Table 2**.

The majority of injuries in all age groups was caused by receiving a punch. In cadets-juniors the punch caused injuries in 100%, and in seniors in 85%. Kicks as a cause of injuries were more frequent in pupils-younger cadets than in seniors (29%:11.9%;  $P=0.038$ ) and cadets-juniors (in this group injuries caused by kicks were not recorded) (Figure 2).

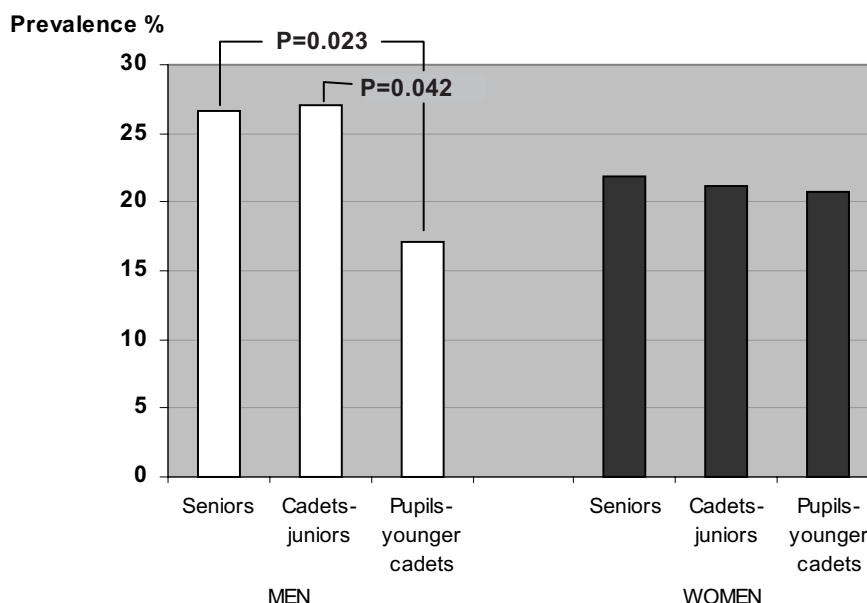
The most frequent localisation of injury in all

**Table 2.** The prevalence of injuries according to age groups and gender.

	Number of injuries/Number of fights (%)			Total
	Seniors	Cadets-juniors	Pupils-younger cadets	
Women	31/142 (21,8)	23/109 (21,1)	6/29 (20,7)	60/28(21,4)
Men	83/311 (26,7)	37/137 (27,0)	26/152 (17,1)	146/6(24,3)
<b>Total</b>	<b>114/453 (25,2)</b>	<b>60/246 (24,4)</b>	<b>32/181 (17,7)</b>	<b>206/880(23,4)</b>

The highest prevalence of injuries was found in male cadets-juniors and seniors (27.0%:26.7%; n.s.). The prevalence of injuries in male pupils-younger cadets was significantly lower than in male cadets-juniors (17.1%: 27.0%;  $P=0.042$ ) and male seniors (17.1%: 26.7%;  $P=0.023$ ). In women, the prevalence of injuries was similar in seniors, cadets-juniors and pupils-younger cadets (21.8%: 21.1%:20.7%; n.s.). There are no significant differences in the prevalence of injuries between women and men in all the studied age groups (Figure 1).

age groups was to the head (Figure 3). Head injuries were less frequent in pupils-younger cadets than in seniors (53.1%: 78.1%;  $P=0.005$ ) and cadets-juniors (53.1%: 85%;  $P<0.001$ ). The lower extremities and trunk were affected more often in pupils-younger-cadets than in seniors (trunk – 21.9%:5.3%; lower extremities – 21.9%:4.4%). Also, the trunk was more often affected in pupils-younger cadets than in cadets-juniors (21.9%:1.7%). Injuries of the lower extremities were not recorded in cadets-juniors.



**Figure 1.** The prevalences of injuries in different age groups.

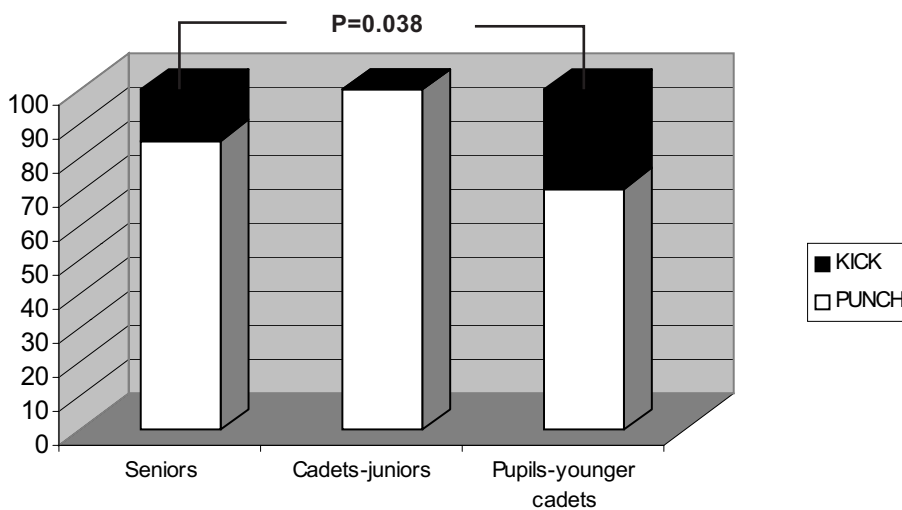


Figure 2. The cause of injuries.

According to severity, the majority of injuries were categorized as grade 1. Six in a total of 206 injuries were categorized as grade 2: fracture of the nasal bone, dislocation of the metatarsophalangeal joint, carpal joint and elbow and two fractures of the metacarpal bone. Grade 3 injuries were not observed (Figure 4).

### DISCUSSION

The prevalence and severity of the injuries connected with martial arts have been investigated in numerous studies. Results of these studies vary significantly due to the differences in the examination of diverse martial arts, the definition of the examined groups and a different metho-

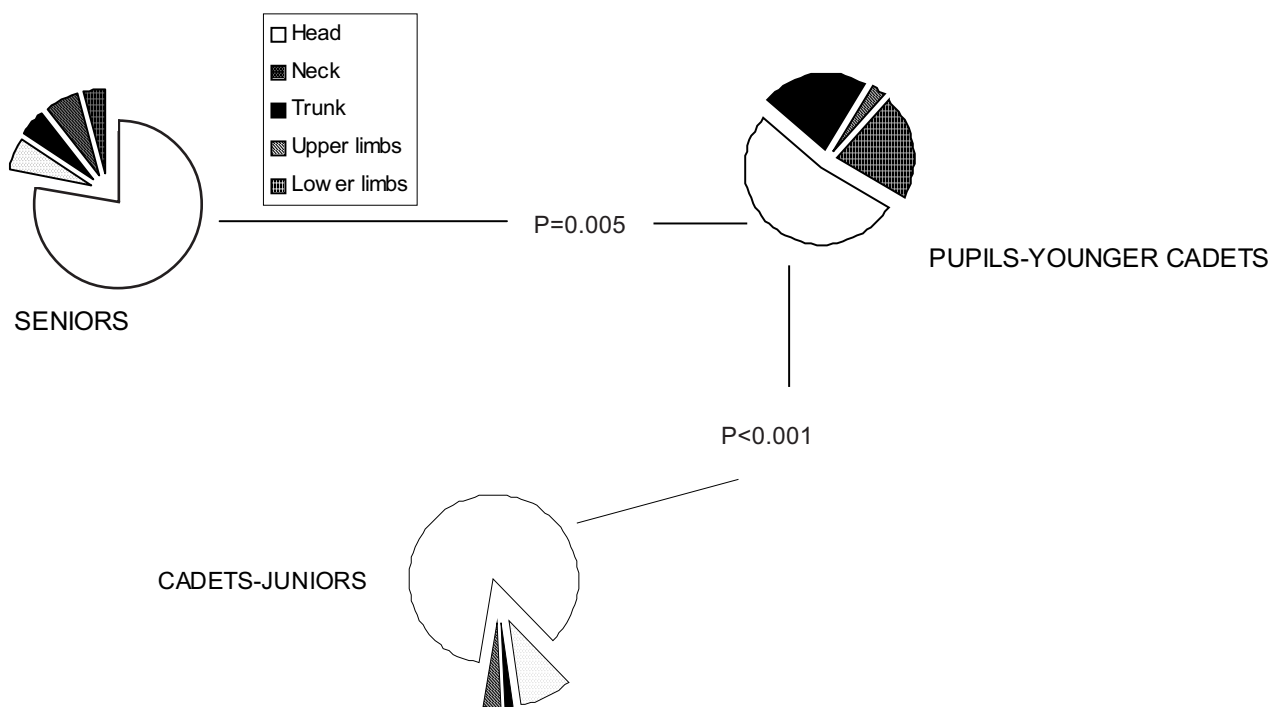
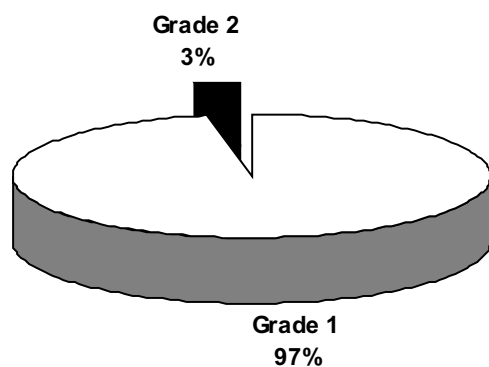


Figure 3. The prevalence of injuries according to localisation on the body.

dology (Stričević et al., 1983). The most frequently studied were karate, judo and taekwondo which differ significantly in techniques and consequently in the frequency, distribution and type of injuries. It is also important to distinguish whether competitive or recreative athletes are examined, were they examined during training (Zetaruk, Violan et al., 2000) or competition and which is their skill level and duration of training. The most common methodological differences between the studies occurred in the method of collecting data on injuries. Some authors record injuries directly from the ring during training or competitions, while others analyse data from the medical archives (Tenvergert et al., 1992) or insurance companies (Kujala et al., 1995). There are few studies that have discussed the results according to age and gender. The results of our study are compared only with methodologically similar studies that examined injuries among competitive athletes with data collected directly from the ring.



**Figure 4.** *The severity of injuries recorded.*

According to Pieter et al. (Pieter et al., 1998) injuries in karate are more frequent than in taekwondo and judo both in women and men. This difference is greater in seniors than in younger age groups. Pieter found injury rates (per 1000 taekwondo fights) of 66.7 for boys and 78.9 for girls; 108.1 for male juniors and 117.6 for female juniors; 140.0 for male seniors and 47.6 for female seniors. Oler (Oler et al., 1991) found 154 injuries per 3700 participants of a taekwondo tournament (4.2%). Stričević and McLatchie observed a frequency of 1 injury per every 4 fights in karate (83 injuries/309 fights – Stričević; 80 injuries/295 fights – McLatchie) (Stričević et al., 1983; McLatchie, 1976). Critchley found a frequency of 160 injuries per 1770 fights (9%) in Shotokan karate competitions (Critchley et al., 1999). In Kyokushinkai karate style (full-contact karate style) the frequency of injuries seems to be much

higher. McLatchie recorded 53% of competitors injured at a Kyokushinkai tournament (McLatchie et al., 1980). The majority of these studies did not discuss the prevalence of injuries according to age and gender with only male seniors as the groups examined.

The results of our study are in accordance with the studies already mentioned. They show the frequency of one injury in every four karate fights, similar in male and female seniors and cadets-juniors. Such results confirm the previous conclusions that the prevalence of injuries in karate is higher than in taekwondo.

In the youngest male age group the prevalence of injuries was significantly lower than in older male age groups. This can be explained by the more rigorous criteria of judges towards uncontrolled blows and also by the mild judge's criteria towards the scoring of blows in the youngest group. Pupils are not required to perform the blows so precisely as juniors or seniors. Also the speed and strength of the pupil's blows are of a lesser degree, resulting in fewer medical interventions. In the group of male juniors and seniors the fights are often very dynamic and sometimes violent with many strong and fast exchanges of blows which increase the risk of injury. In women, the prevalence of injuries was similar in all the examined age groups, probably as a consequence of the small number of fights in the youngest female age group in which a lower frequency of injuries is expected.

A punch as the most common cause of injury in all age groups is easily understandable, because in karate fights the majority of attacks and counter-attacks are performed with hand techniques (McLatchie, 1981). Leg techniques are more complex and of longer duration and for the attacker it is often hard to keep one's balance during or after performing a kick. That increases the opportunity for the opponent's counter-attack (Kuleš, 1998). In the group of pupils-younger cadets significantly more injuries were caused by kicks than in seniors (29%: 11.9%;  $P=0.038$ ). The youngest age group uses leg techniques more than older ones, probably because they are more attractive, but due to lack of experience, fault of tactics and bad technical performance often results in more frequent injuries.

The majority of injuries were localized on the head. As mentioned before, karate technique prefers punches directed to the head which is also anatomically more sensitive than the trunk. Actions during a karate fight are very fast and often a slight move of the defender's head during an attack results in an uncontrolled punch and injury. Injuries of the trunk and lower extremities were more

frequent in the youngest age group than in cadets-juniors and seniors, because pupils more often perform technically poorly executed leg as well as defensive techniques. We must bear in mind that this is the youngest age group and it is more liable to sustain injuries due to their weaker body structure.

Almost all the recorded injuries were categorized as grade 1, allowing the competitor to continue with the competition. This is primarily a consequence of the karate rules that do not allow one to injure the opponent. In spite of that, prevention of injuries must be taken very seriously, because data from literature point out the cases of severe, even lethal injuries that have taken place during martial arts competitions (Oler et al., 1991; McLatchie et al., 1980; Zemper et al., 1989). Obligatorily protective equipment (gloves, gumshields, pads) as well as strict judging and vigorous penalties for uncontrolled blows, particularly in the youngest competitive athletes, can significantly decrease the risk of serious injuries (Sudačka komisija Hrvatskog karate saveza, 1994.).

Adequate technical and tactical training procedures and care about the athlete's general condition including adequate exchange of training and rest and a proper diet have an important role in the prevention of injuries. Sufficient cooperation of physicians, judges and members of the Board for competitions of the Croatian karate union should exclude all ill or injured athletes from the competition. Competitions should take place in areas with a suitable microclimate and floor padding ("tatami") and should be organized optimally according to the physiology of the human body and demands of the sport (McLatchie, 1979.; Zetaruk, Zurakowski et al., 2000.).

## CONCLUSION

Karate in Croatia is a safe sport on condition that optimal training principles and competition conditions are insured. Due to its attractiveness and positive influence on the development of the functional and motoric abilities as well as its possible application in recreative form, karate practice may be recommended to all age groups.

## REFERENCES

1. Critchley, G.R., Mannion, S., Meredith, C.(1999). *Injury rates in Shotokan karate*. *British Journal of Sports Medicine*, 33(3),174-177.
2. Frederic, L.(1995): *A dictionary of the martial arts*. Boston:Charles E.Tuttle Company Inc.
3. Kujala, U.M., Taimela, S., Antti-Poika, I., Orava, S., Tuominen, R., Myllynen, P.(1995). Acute injuries in soccer, ice hockey, volleyball, basketball, judo and karate: analysis of national registry data. *British Medical Journal*, 311:1465-8.
4. Kuleš, B.(1998). *Trening karatista*. [Training of the karatekas. In Croatian.]. Zagreb: Grafokor.
5. McLatchie, G.R.(1976). Analysis of karate injuries sustained in 295 contests. *Injury*, 8:132-134.
6. McLatchie, G.R.(1979). Recommendations for medical officers attending karate competitions. *British Journal of Sports Medicine*, 13:36-37.
7. McLatchie, G.R., Davies, J.E., Caulley, M.B. (1980). Injuries in karate – A case for medical control. *Journal of Trauma*, 20(11),956-958.
8. McLatchie, G.R.(1981). Karate and karate injuries. *British Journal of Sports Medicine*, 15:84-86.
9. Oler, M., Tomson, W., Pepe, H., Yoon, D., Branoff, R., Branch, J.(1991). Morbidity and Mortality in the Martial Arts: A Warning. *Journal of Trauma*, 31(2),251-253.
10. Pieter, W., Bercades, L.T., Heijmans, J. (1998). *Natjecateljske ozljede u olimpijskom taekwondou*. [Injuries in competitive olympic taekwondo. In Croatian.]. *Kinesiology*, 30(1),21-29.
11. Sabolić, K., ured.(1994). *Hrvatski športski almanah 1994.-1995*. [Croatian sport's bulletin 1994.-1995. In Croatian.], Zagreb: Ars Media, Hrvatski olimpijski odbor.
12. Stričević, M.V., Patel, M.R., Okazaki, T., Swain, B.K.(1983). *Karate: Historical perspective and injuries sustained in national and international tournament competitions*. *American Journal of Sports Medicine*, 11(5),320-324.
13. Stričević, M., V., Dačić, D., J., Mijazaki, T., Anderson, G.(1990). *Moderni karate-Naučni pristup kondiciji i treningu*. [Modern karate - Scientific approach to conditioning and training. In Croatian.]. Novi-Sad: Prometej.
14. Sudačka komisija Hrvatskog karate saveza/ Board of judges, Croatian karate union/ (1994). *Pravila karate natjecanja*. [The rules of karate competitions. In Croatian.]. Zagreb: Hrvatski karate savez.
15. Tenvergert, E.M., Ten Duis, H.J., Klasen, H.J.(1992). Trends in sports injuries, 1982-1988: an in-depth study on four types of sport. *Journal of Sports Medicine and Physical Fitness*, 32(2),214-220.
16. Zemper, E.D., Pieter, W. (1989). Injury rates during the 1988 US Olympic Team trials for taekwondo. *British Journal of Sports Medicine*, 23(3),161-164.
17. Zetaruk, M.N., Violan, M.A., Zurakowski, D., Micheli, L.J. (2000). Karate injuries in children and adolescents. *Accident Analysis & Prevention*, 32(3),421-425.
18. Zetaruk, M.N., Zurakowski, D., Violan, M.A., Micheli, L.J. (2000). Safety recommendations in Shotokan karate. *Clinical Journal of Sport Medicine*, 10(2),117-122.

## UČESTALOST I DISTRIBUCIJA OZLJEDA U NATJECATELJSKOM NEKONTAKTNOM KARATEU

### SAŽETAK

### UVOD

Cilj je ovog istraživanja bio utvrditi učestalost, lokalizaciju i težinu ozljeda nastalih tijekom karataških borbi u sklopu službenih natjecanja Hrvatskog karate saveza.

### METODE I ISPITANICI

Podaci su prikupljeni 1997. godine tijekom jesenske natjecateljske sezone, na županijskim i državnim prvenstvima u nekontaktnom karateu za sve dobne kategorije te na izbornom državnom turniru za odlazak na seniorsko svjetsko prvenstvo. Natjecanja su se odvijala prema pravilima WUKO (World Union of Karate-do Organizations) pravilima. Istraživanje je provedeno odvojeno sa ženama i s muškarcima u tri dobne kategorije: učenici/učenice - mlađi kadeti/kadetkinje (10-14 godina), kadeti/kadetkinje – juniori/juniorke (15-21 godinu) i seniori/seniorke (18 godina). Ukupno je praćeno 880 borbi. Podaci o spolu i dobi sportaša te o lokalizaciji, težini i načinu zadobivanja ozljeda dobiveni su upitnikom koji je popunio autorna borilištu za vrijeme natjecanja. Prema težini ozljede su kategorizirane u lake (stupanj 1), srednje teške (stupanj 2) i teške (stupanj 3). Prema lokalizaciji ozljede su podijeljene u ozljede glave, vrata, trupa (uključujući genitalije) te gornjih i donjih ekstremiteta. Bilježen je i način zadobivanja ozljede, je li ona posljedica udarca rukom ili nogom. Za određivanje značajnosti razlika u učestalosti i distribuciji ozljeda prema dobi i spolu korišteni su neparametrijski testovi, a vrijednost  $P \leq 0,05$  smatra se statistički značajnom.

### REZULTATI I RASPRAVA

Ukupno je u 880 borbi zabilježeno 206 ozljeda. U muškaraca, učenici – mlađi kadeti imali su značajno manju učestalost ozljeda od kadeta - juniora (17,1%: 27,0%;  $P=0,042$ ) i seniora (17,1%: 26,7%;  $P=0,023$ ). U žena, učestalost ozljeda bila je podjednaka u seniorki, kadetkinja - juniorki i učenica - mlađih kadetkinja (21,8%: 21,1%:20,7%; n.s.). Nije utvrđena statistički značajna razlika u učestalosti ozljeda između muškaraca i žena svih dobnih skupina. Najčešći uzrok ozljede u svim dobnim skupinama bio je udarac rukom. U učenika - mlađih kadeta značajno

više ozljeda uzrokovano je nožnim udarcima nego u seniora (29%:11,9%;  $P=0,038$ ). U svim dobnim skupinama dominirale su ozljede glave. U učenika - mlađih kadeta više su zastupljene ozljede trupa i donjih ekstremiteta nego u seniora (trup - 21,9%:5,3%; noge – 21,9%:4,4%). S obzirom na težinu ozljeda, u većini slučajeva radilo se o lakim ozljedama. U svega 6, od ukupno 206 zabilježenih ozljeda, radilo se o težim ozljedama zglobova i kostiju koje su kategorizirane u skupinu srednje teških ozljeda, a to su bile: fraktura nosne kosti, luksacija metatarzofalangealnog zgloba, luksacija karpalnog zgloba, dvije frakture metakarpalne kosti i luksacija lakta. Teške ozljede nisu zabilježene.

U svjetskoj literaturi postoje brojni radovi o učestalosti i težini ozljeda tijekom bavljenja borilačkim sportovima. Rezultati tih istraživanja dosta se međusobno razlikuju zbog proučavanja različitih borilačkih sportova, različito definiranih skupina ispitanika i istraživačkih metodoloških razlika. Najčešće su se istraživanja provodila u karateu, judu i tekvandou. U istraživanjima karatea problem izaziva postojanje mnogobrojnih škola karatea koje se međusobno znatno razlikuju u tehnicima i pravilima borbe, što dovodi do zbrke u rezultatima koji se odnose na ozljede zadobivene u karataškim borbama. Naši su rezultati u skladu sa sličnim istraživanjima koja su proveli drugi autori, jer pokazuju učestalost od približno 1 ozljede na svake 4 nekontaktna karate borbe, podjednako u oba spola, seniora i juniora, a i potvrđuju da je učestalost ozljeda u nekontaktnom karateu veća nego u tekvandou.

U skupini učenika učestalost ozljeda je značajno manja nego u seniora i juniora, što se može objasniti oštrijim (strožim) sudačkim odnosom prema nekontroliranim udarcima. U toj je dobnj skupini kriterij za bodovanje udaraca blaži, pa učenici ne moraju izvoditi udarce tako precizno kao juniori i seniori. Brzina i snaga udaraca u učenika je također manja, što doprinosi manjoj potrebi za liječničkim intervencijama. U skupini juniora-kadeta i seniora je, zbog vrlo dinamičnih, često i žestokih borbi s mnogo brzih i snažnih udaraca, učestalost ozljeđivanja veća.

Rezultat da je udarac rukom najčešći uzrok ozljeda u svim dobnim skupinama očekivan je i razumljiv jer se tijekom borbe pretežno izvode napadi i kontranapadi ručnim tehnikama. Nožne tehnike su složenije, duže traju i napadač je često



tijekom ili nakon izvođenja udarca u nestabilnom ravnotežnom položaju, čime protivniku pruža veću šansu protivniku za kontranapad. U skupini učenika-mlađih kadeta značajno je više ozljeda uzrokovano nožnim udarcima nego u seniora. Najmlađa dobna skupina više koristi nožne tehnike najvjerojatnije zbog njihove atraktivnosti, ali s obzirom na borbeno neiskustvo, nedostatak taktike i lošiju tehničku izvedbu to rezultira sa češćim ozljedama.

Najviše ozljeda je lokalizirano na glavi zbog same tehnike karatea. U borbi prevladavaju udarci usmjereni prema glavi, a područje glave je i anatomski osjetljivije na ozljede od trupa. Akcije tijekom karate borbe vrlo su brze, pa se često događa da već i mali pomak glave borca koji se brani za vrijeme dok napadač izvodi napad u glavu rezultira nekontroliranim udarcem i ozljedom. Ozljede trupa i donjih ekstremiteta učestalije su u najmlađoj dobnoj skupini nego u kadeta - juniora i seniora zbog češće upotrebe loše tehnički izvedenih nožnih, kao i obrambenih tehnika. U obzir treba uzeti i činjenicu da se radi o najmlađoj dobnoj skupini koja je zbog nježne tjelesne građe podložnija ozljedama.

Rezultati ovog istraživanja pokazuju da su ozljede zadobivene tijekom karate borbi uglavnom lake, tj. da borac radi njih ne mora prekinuti natjecanje. Razlog tome prvenstveno treba tražiti u pravilima karatea kojima se zabranjuje protivniku nanijeti ozljede. Prevenciji ozljeda, međutim, treba posvetiti veliku pažnju s obzirom da neki literaturni podaci govore o vrlo teškim, pa i smrtonosnim

ozljedama koje su se dogodile tijekom natjecanja u borilačkim sportovima.

Mogućnosti za zadobivanje težih ozljeda smanjuju se obveznim nošenjem zaštitne opreme te striktnim suđenjem i ostrim kažnjavanjem nekontroliranih udaraca, naročito u najmlađim dobnim skupinama. Značajna je uloga trenera u prevenciji ozljeda u vidu pravilne tehničke i taktičke pripreme natjecatelja, ali i vođenjem računa o općem stanju natjecatelja (pravilan ritam treninga i odmora, adekvatna prehrana). Preventivno će djelovati redoviti i sistematski pregledi sportaša-natjecatelja, koji će, uz pravilan rad sudaca i članova natjecateljske komisije, onemogućiti bolesnim ili ozljeđenim natjecateljima sudjelovanje u borbi. Odvijanje natjecanja u mikroklimatski adekvatnim prostorima s obaveznom mekom podlogom te optimalna organizacija natjecanja također su značajni čimbenici u prevenciji ozljeda.

## ZAKLJUČAK

Rezultati ovog istraživanja pokazuju da je nekontaktni karate u Hrvatskoj danas siguran sport pod uvjetom daljnjeg pridržavanja navedenih pravila treninga i natjecanja. S obzirom na njegovu atraktivnost i pozitivan utjecaj na razvoj funkcionalnih i motoričkih sposobnosti te na mogućnost primjene i u rekreativnom obliku, može se preporučiti svim dobnim skupinama.

***Ključne riječi:** ozljede, nekontaktni karate, prevencija*

Correspondence to:

Jelena Macan

Institute for medical research and occupational health

Ksaverska cesta 2, 10000 Zagreb, Croatia

Tel.: +385 1 2347884

Fax.: +385 1 2321252

e-mail: [jmacan@imi.hr](mailto:jmacan@imi.hr)