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# Low Risk of Injuries in Young Adolescents Participating in Top-Level Karate Competition

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**Background:** Prospective studies on injuries in martial arts competition are scarce, especially those involving young practitioners, but the upsurge of children and adolescents taking part in organized training and competition in these sports requires clarification of the injury risk that they represent for youths.

**Hypothesis:** Top-level karate competition for young adolescents (cadets, or 14- to 15-year-olds) has a low injury rate and can be safely promoted.

**Study Design:** Descriptive epidemiological study.

**Methods:** Prospective recording of the injuries resulting from all bouts in 3 consecutive World Karate Championships (2009, 2011, and 2013) for cadets was performed. Data were collected prospectively in situ with checklists that described competitor sex, bout category, and weight as well as injured area, diagnosis, mechanism of injury, severity, and treatment.

**Results:** A total of 1020 bouts were reviewed, 671 in the male category and 349 in the female category. A total of 61 injuries were recorded. Of those, only 3 were time-loss injuries. During the 2009 and 2011 championships, there was 1 injury per 25.6 fights, while during the 2013 championship the number of injuries increased, with 1 injury per 10 fights ( $P = .003$ ). There was no statistical difference in the total injury rate between the male and female categories ( $P = .71$ ), with an odds ratio of 1.16 (95% CI, 0.52-2.55).

**Conclusion:** The injury rate for cadet top-level karate competition found in this prospective study is much lower than the rates previously published for karate or other martial arts competitions, but there seems to be a marked increase as more championships are held, which is a matter of concern.

**Keywords:** karate injuries; cadet karate competition; youth karate competition; martial arts injuries

The participation of children in martial arts has increased markedly during the past decade. It increased 28.2% between 2000 and 2004, with an estimated 6.5 million children in the United States involved in 2004; in some regions of the US, enrollment of children in martial arts such as karate more than doubled during the past decade.<sup>1</sup> Some of those children remain at a recreational level, but many others proceed to participate in organized competition, and parents seek advice on the risk of the sport participation. Prospective studies on injuries in martial arts competition are scarce, and very little research is available on the injury risk of children and

adolescents participating in organized martial arts competition, especially at top levels (ie, World Championships). Even at the recreational level, most of the published studies are retrospective.<sup>13,16</sup> In karate, most of the available research pertains to adult athletes, and published papers that report on the injuries of young karate players refer to the local or national level<sup>12</sup> or even to children practicing karate but not taking part in competitions or tournaments<sup>17</sup>; however, there are no studies reporting injuries in children's top-level karate competition. Nevertheless, the support given by the International Olympic Committee to continental- and international-level competition for cadets (adolescents 14-15 years of age) makes it very important to clarify the safety of the competition for this age group.

Participants compete in a range of styles of karate in which different sparring rules are used, ranging from noncontact to semicontact to full-contact. The rules used by the World Karate Federation (WKF; the karate association recognized by the International Olympics Committee) for competition involving cadets allow only controlled (limited) contact to the torso, whether the player is using kicking or punching techniques. The rules provide a greater level of protection for contact to the face and head. In cadet karate competition, special protective equipment is worn by the athletes. As in

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juniors' and seniors' competition, hands, feet, shins, and body are covered by equipment designed to protect both the competitor and his or her opponent. Girls also wear a chest guard designed to protect the breasts. A special face mask is used to offer added protection to the face, even when face and head contact with punch techniques is forbidden, and only light contact (skin-touch) is allowed with kicks.<sup>15</sup>

Although injuries in martial arts are bound to occur, every effort must be made to prevent the occurrence of unnecessary injuries. There is an inherent risk of injury in combative martial arts, as there is with any collision or contact sport, but offering protection to young children is paramount. Due to the paucity of data on injuries sustained by children participating in organized, top-level karate competition, we wanted to investigate whether the sport is a safe activity for them. We reported on the injuries sustained by young adolescents (aged 14-15 years) competing in the cadet category during the first 3 World Karate Championships held in 2009, 2011, and 2013.

## METHODS

A total of 1020 adolescent fights (age, 13-15 years; 671 in the male category and 349 in the female category) in the cadet category of the World Karate Championships were included in this study, representing all cadet competitions in the 3 championships held thus far. The 2009 championship (held in Rabat, Morocco) entailed a total of 352 fights; the 2011 championship (Melaka, Malaysia) 325 fights; and the 2013 championship (Guadalajara, Spain) 343 fights. All authors obeyed the rules of the Helsinki Declaration, and an ethics committee approved the study, as only data from the injuries were recorded, without any information that could allow identification of the athletes.

The rules of the WKF state that before athletes are allowed to enter a championship, they have to be declared fit to compete by their local medical authorities, and a medical certification has to be issued accordingly; in this sense, most (if not all) the injuries reported to the tournament doctors should be judged as acute ones. Injuries sustained during all bouts in the 3 consecutive World Karate Championships for cadets were prospectively recorded in situ on checklists as per Appendix 1 (available online at <http://ajsm.sagepub.com/supplemental>) following the same protocols used in previous investigations.<sup>2,3</sup> In addition to caring for injured athletes, the medical teams were also responsible for recording injuries that took place during the competition. Every injury that was seen by the tournament doctors was registered, no matter how minor. For each tatami (individual competition area), there was 1 doctor plus 1 assistant responsible for medical support. According to the karate competition rules for cadets, whenever there was a suspected injury on the tatami, the doctor was called by the referee to assess the competitor and provide treatment if necessary. If medical assistance was sought by the athletes at any time during the competition, diagnoses were also recorded as a way to decrease the risk that subjective decisions by referees could prevent injuries from being recorded. Data were collected with checklists that described the competitor country, sex, category, and weight as well as

the injured area, diagnosis, mechanism of injury, severity, and treatment. No names or other personal information was registered, to guarantee anonymity. As World Championships are held every 2 years in different locations, and in an effort to standardize data collection, before the commencement of each championship, the senior author (R.A.; as part of the Medical Commission of the WKF) instructed the local doctors and physician assistants on the injury-recording procedure; the senior author also reviewed the recorded data in situ, 3 times per day, to clarify any possible doubts and to ensure uniform injury classification (Appendix 2, available online). This method followed the same criteria used in the World Karate Championships since 1992: Standard medical diagnosis and predetermined severity index (Appendix 2) were used, as there is no possible system to track the athletes after they leave the competition venue to return to their home countries (athletes from >100 countries registered for participation at each of the championships were analyzed, and many teams traveled without a doctor or medical authority). Before entering the championships, athletes and their representatives signed the informed consent to allow for injury registration and treatment.

To allow comparison with other combat sports, time-loss injuries are defined as those that prevent the athlete from completing the present bout and/or subsequent bouts and from participating in karate for a minimum of 1 day thereafter.<sup>4</sup>

Injury rates were calculated as follows:  $(\text{Number of injuries} \div \text{Number of athlete-exposures [AEs]}) \times 1000 = \text{Number of injuries per 1000 AEs}$ . One AE refers to 1 individual participating in a bout where he or she is exposed to the possibility of being injured. Each bout lasted 2 minutes, and the clock was stopped every time that the bout was called to a halt by the referees.

Statistical analysis was conducted to identify risk factors for the presence or absence of injury, including sex and championship. All data were documented on SPSS (v17; IBM Corp) and analyzed. The phi and the Cramer V correlations were used to assess the significance of each predictor, odds ratios (ORs) were computed for each risk factor, and 95% confidence intervals (CIs) were constructed. A 2-tailed  $P < .05$  was considered statistically significant.

## RESULTS

In total, 848 athletes participated in the 3 championships; 562 were boys and 286 were girls. A total of 1020 fights (671 in the male category and 349 in the female category) in the cadet category of the World Karate Championships were included in the study, representing 2040 minutes of competition. Because 2 athletes were simultaneously exposed to injury in each fight, this resulted in a total of 4080 exposure minutes.

During the 3 championships, a total of 61 injuries were recorded (Table 1). All of them were acute injuries. Of those, only 3 were time-loss injuries (a concussion, a broken nose, and a hallux first phalanx fracture), all involved males, and 1 of these injuries took place in each championship. There were 54 minor contusions that did not make the athletes stop the competition (32 in the male category and

TABLE 1  
Injuries Sustained During the World Championships  
of Karate for Cadets (N = 1020 Fights)

	No. of Injuries	
	Male (n = 671 Fights)	Female (n = 349 Fights)
Concussion <sup>a</sup>	1	0
Fracture hallux phalanx <sup>a</sup>	1	0
Fractured nose <sup>a</sup>	1	0
Epistaxis	2	2
Face or head contusion	22	13
Abdominal contusion	2	3
Leg contusion	7	5
Minor tracheal contusion	1	1
Total	37	24

<sup>a</sup>Time-loss injuries.

22 in the female category), and 4 self-limited epistaxis (2 in the male category and another 2 in the female category), neither of which required competitor withdrawal or further treatment. There were 29.9 injuries per 1000 AEs, most of them minor ones (95%). There were 1.47 time-loss injuries per 1000 AEs. There was no statistical difference in the total injury rate between the male and female categories ( $P = .71$ ), with an OR of 1.16 (95% CI, 0.52-2.55).

During the 2009 championship, there were 13 injuries in 352 fights (18.46 injuries/1000 AEs); during the 2011 championship, 17 injuries in 325 fights (26.15 injuries/1000 AEs); and during the 2013 championship, 31 injuries in 343 fights (45.18 injuries/1000 AEs). The increase in injuries shows a significant Cramer V and contingency coefficient ( $P = .010$ ). Nevertheless, the rate of important (time-loss) injuries remained at only 1 per championship.

As the main increase in the rate of injuries seemed to occur at the 2013 championship, a specific comparison was made between the results found at that championship with the ones of the 2 previous championships pooled together: There were 30 injuries in 677 fights during the 2009 and 2011 championships (22.15 injuries/1000 AEs), and 31 injuries in 343 fights during the 2013 championship (45.18 injuries/1000 AEs). The comparison showed a significant increase for the 2013 championship ( $P = .003$ , phi).

## DISCUSSION

The main finding of this study is that globally, cadet karate competition has a low injury rate when performed at top level and under the rules of the WKF and most of the injuries are very minor (95% of the injuries were contusions and self-limited epistaxis that did not require further treatment or competitors' withdrawal from competition), but when the 3 championships are analyzed independently, a tendency toward a progressive increment in the injury rate becomes evident.

We can only speculate about the reasons for the tendency toward an increase in the injury rate as the championships have gone on, for the rules have not changed and the protective equipment worn by the athletes has remained

unchanged. One of the possible explanations is that coaches and trainers might have put higher degrees of pressure on the children to obtain prizes (medals) at World Karate Championships once the competition was confirmed as an official event, thus making it possible to include the results in the national federations' rankings. In that way, the limits for children's safety would have been shifting toward the ones used for their older counterparts, who have higher injury rates.<sup>3</sup>

Unfortunately, little systematic prospective research has been conducted to obtain further data on injuries sustained by young athletes or to study the effects of the alteration of risk factors and/or physical training on the incidence or severity of these injuries. Experts in the field of pediatric sports medicine and epidemiology have called for unified surveillance systems to accurately document injuries in young athletes and guide prevention efforts.<sup>7</sup>

The results found in this study, along with the standardization of reporting, may provide a benchmark to which future cadet karate competition data could be compared. However, at present, different martial arts have different competition rules, and even within karate itself, different associations run their own championships under different rules. Previously published studies focusing on top-level karate competition injuries were undertaken within adult competition and with different rules<sup>2,3</sup> and therefore do not allow for direct comparison. There are also variations in terms of protective equipment allowed, level of competition,<sup>12</sup> and the degree of contact tolerated by the referees, which makes comparison of published data very difficult. Comparison of injury risk among different sports and even different categories within the same sport is challenging, due to variable definitions. This could include definition of reportable injury, risk of injury exposure, diversity of study populations with respect to differences in competition rules, and small sample sizes in some studies.

Children's involvement in competitive sports poses an inherent injury risk that must be weighed against the benefits of an athletic lifestyle. Caine et al<sup>7</sup> believed that all those who work with young athletes should consider the following questions: What is the risk for injury in children's and youth sports? Is the risk for injury greater in some sports or levels of participation compared with other sports? Are some physical, psychological, or sports-related factors associated with an increased risk for injury? We believe that the results presented in this paper will help researchers to compare the results of other sports and will give insight to the first 2 questions.

Some authors believe that more training should correlate with lower injury incidence, and this is supported by research indicating a significant inverse relationship between children's taekwondo rank and their injury incidence,<sup>6,14</sup> but it has also been suggested that as skill level increases, so do physical demands during combat, as well as force generated. More skilled athletes are potentially more likely to use dangerous techniques or execute fundamental ones with greater strength and speed, as has been shown in soccer.<sup>8</sup> It is therefore also possible that injury incidence may be higher in elite athletes, which potentially puts our study population (young adolescents competing at top level) at an increased risk of injury. It has been suggested

that young taekwondo athletes require extra safety precautions, for example, greater referee vigilance or extra protective equipment,<sup>10</sup> as it has been shown in previous studies that young competitors, male or female, were more likely to sustain injury during competition than their adult counterparts.<sup>5</sup> Fortunately, this was not proved so in our study. With an overall injury rate of 29.9 per 1000 AEs, and especially considering that most of the injuries were very minor ones, cadet karate competition can be considered to be particularly safe relative to other combat sports in this age group<sup>13</sup> and safer than taekwondo competition at any age. Cadet karate competition is also safer than karate competition in adults under the actual rules.<sup>3</sup> A published meta-analysis on injuries in taekwondo competition did not find any evidence that sex, age, or the level of play had any significant effect on the overall injury incidence rates, which were pooled to 79.3 per 1000 AEs,<sup>11</sup> although the incidence of injuries in male adolescent judo players found by Salanne et al<sup>13</sup> was clearly higher than in females.

The rate of injuries in some studies that focused on young karate athletes has been relatively high for a semi-contact sport: In the study by Pieter<sup>12</sup> on the injuries sustained by 7- to 15-year-old competitors in Holland, there was no notable difference in injury rate between boys and girls: 99.74 per 1000 AEs (95% CI, 77.32-122.16) versus 115.11 per 1000 AEs (95% CI, 75.23-154.99), but the injury incidence is 4-fold greater than the one found in the present study (29.9 injuries/1000 AEs), even though the study population is not paired. One possible explanation lies in the different rules allowed by the different karate governing bodies around the world for different levels of competition. Even though younger competitors were included in other studies, the injury rate found in the present study is substantially lower. That is true even though the criteria used in our study to define an injury were more strict than the ones used in other studies of sports injuries in children and adolescents; for example, in the soccer study by Froholdt et al,<sup>9</sup> injuries were registered if they occurred during a scheduled soccer match or training session, caused the player to miss part of or the rest of the match or training session, or required medical treatment.

A possible weakness of this study is that athletes were enrolled by age and not by physical and skeletal maturity, which could be quite different in different populations; 14- to 15-year-old children could represent a wide spectrum of maturity, but this is the age group included in the cadet category. Determining the participants' degree of maturity (ie, Tanner stage) would have represented a problem, as most young competitors at World Championships are not accompanied by their parents, and obtaining permission could have proven difficult at best.

## CONCLUSION

The injury rate for cadet top-level karate competition found in this prospective study is much lower than the rates previously published in other age groups in karate and also lower than the injury rates published for other sports involving adolescents.

Top-level karate competition in the 14- to 15-year age group is safe and, thus, could be spread worldwide using the strict rules applied by the WKF, but the increase in injury rates found in the 3 consecutive championships analyzed requires a strict follow-up to confirm this finding and apply corrective measures if required.

This study presents a potential reporting method for injuries in cadet top-level karate competition and may allow for comparison with other sports and evaluation of the effect of future rule modifications within karate.

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