COMPETITION INJURIES IN OLYMPIC TAEKWONDO

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Abstract

The purposes of this study were to assess the competition injury profile of young (n=139 males, n=43 females) and adult (n=102 males, n=24 females) taekwondo athletes and to compare their total injury rates. Simple check-off forms were used to collect the injury data. Non-parametric procedures were used to determine the difference in injury rates per 1,000 athlete-exposures (A-E) between the various age groups. All analyses were carried out with α=0.05. Within the females, the Juniors (13-16 years) recorded a higher injury rate (117.7/1,000A-E) than their adult counterparts (47.6/1,000 A-E) ($p<0.05$). Within the males, the children (<13 years) had a lower ($p<0.01$) injury rate (66.7/1,000 A-E) than the Juniors (108.1/1,000 A-E), but a higher rate than the Seniors (51.3/1,000 A-E). Collapsed over age group, the females recorded a lower injury rate (79.0/1,000 A-E) than the males (88.0/1,000 A-E) ($p<0.01$). The major injury type, regardless of age group, was the contusion with the major body part injured being the foot (girls, boys, Junior boys) and the jaw (Senior men). The major injury mechanisms were delivering a round kick (girls, Junior boys) and receiving a round kick (boys). The injury rates recorded by the young taekwondo athletes are comparable with those found in young semi-contact karate athletes, while the adult athletes had lower rates than their elite counterparts in taekwondo. It is recommended to introduce padding for the foot during competition to help reduce injuries to this body part.

Key words: injuries, Olympic taekwondo, injury rates

Zusammenfassung:

WETTKAMPFSVERLETZUNGEN IM OLYMPISCHEN TAEKWANDO

Die Ziele dieser Untersuchung waren, die Wettkampfsverletzungen unter den jungen (n=139 Jungen, n=43 Mädchen) und erwachsenen (n=102 Männer, n=24 Frauen) Taekwando-Kämpfern zu bewerten und ihre Gesamtverletzungsraten zu vergleichen. Die Daten wurden mittels eines einfachen "ja/nein" Fragebogens gesammelt. Unterschiede in Verletzungsraten auf 1000 Sportleraussetzen (A-E) wurden mittels nicht-parametrischer Verfahren festgestellt. Alle Daten wurden mit α = 0,05 analysiert. Die Juniorkämpferinnen (13-16 Jahre) hatten eine höhere Verletzungsrate (117,7/1000 A-E) im Vergleich zu Seniorkämpferinnen (47,6/1000 A-E) ($p<0,05$). Bei den Männern hatten die Jungen (<13 Jahre) eine niedrigere ($p<0,01$) Verletzungsrate (66,7/1000 A-E) als die Junioren (108,1/1000 A-E), aber eine höhere als die Senioren (51,3/1000 A-E). Über alle Altersgruppen gesehen, hatten die Kämpferinnen eine niedrigere Verletzungsrate (79,0/1000 A-E) als die Kämpfer (88,0/1000 A-E) ($p<0,01$). Der Haupverletzungstyp, geschlechtsunabhängig, war die Kontusion und die am häufigsten verletzten Körperteile waren der Fuß (Mädchen, Jungen, Junioren) und der Kiefer (Senioren). Der Hauptverletzungsmechanismus war das Versetzen (Mädchen, Junioren) und das Erhalten (Jungen) vom Kreisfußstoß. Die Verletzungsrate der jungen Taekwando-Kämpfer sind mit den Verletzungsraten der jungen semi-kontakt Karatekas vergleichbar, während die Karate-Senioren eine höhere Verletzungsrate als Taekwando-Spitzenkämpfer hatten. Eine Fußbandage während des Wettkampfs wird empfohlen, damit Fußverletzungen reduziert werden.

Schlüsselwörter: Verletzungen, olympisches Taekwando, Verletzungsrate

Introduction

Prospective epidemiological studies on injuries in full-contact Olympic taekwondo are scarce. Most of them involve adult athletes (e.g. Oler et al., 1991; Pieter et al., 1995; Zemper and Pieter, 1989), while only a handful have dealt with young taekwondo athletes (e.g., Oler et al., 1991; Pieter and Zemper, 1997a). The total injury rate for adult men recorded during one international tournament, for instance, was found to be 139.54 injuries per 1,000 athlete-exposures (A-E) (Pieter et al., 1995). The rate for the women was 96.49/1,000 A-E. One athlete-exposure (A-E) refers to one individual competing in one bout where he/she is exposed to the possibility of being injured. The body part most often injured in the males was the instep of the foot and

females, the upper leg. The most often occurring injury type was the contusion, which was also found in other studies on injuries in martial sports (e.g. Blijd et al., 1995; Pieter and De Crée, 1997; Zemper and Pieter, 1989). For both adult male and female taekwondo athletes, the major injury mechanism was delivering a round kick (Pieter et al., 1995).

In young (6 - 16 years) taekwondo athletes participating in several tournaments, the rates were 58.34/1,000 A-E (boys) and 56.57/1,000 A-E (girls), which were statistically not different ($p<0.05$) (Pieter and Zemper, 1997a). The most often injured body part was the head in both boys and girls, while the most often occurring injury type was the contusion. The major injury mechanism was receiving a blow (Pieter and Zemper, 1997a), which is hypothesized to be the round kick (Pieter, 1995b). However, no specific taekwondo technique has so far been implicated in the occurrence of competition injuries in young athletes.

No studies on injuries could be found that compared young and adult male and female taekwondo competitors. Most of the prospective research available on injuries in taekwondo has focused on high-performance athletes. Less is known about injuries occurring at lower levels of competitions. Also, most of the aforementioned studies, such as those by Pieter et al. (1995) and Zemper and Pieter (1989) have not analyzed their data statistically. As a result, the purposes of this study were to assess the competition injury profile of young and adult taekwondo athletes competing at a lower than elite level, and to statistically compare their total injury rates. In addition, the injury mechanisms were assessed in both young and adult athletes.

Methods

Data were collected at an open taekwondo tournament in the United Kingdom. A total of 241 males and 67 females competed in this single elimination competition. Regardless of belt rank, the boys and girls competed in the <13-year-age group, while the Juniors, were classified as those between 13 and 16 years. The Senior men were divided into two groups: those wearing color and those wearing black belts. The Senior females were grouped together regardless of belt rank.

Injury data were collected by project staff with simple check-off forms that describe the athlete and nature, site, circumstances, and severity of the injury. A form was completed for every injury for which treatment was sought by the athletes from the medical staff at the competition site. An injury was defined as any circumstance for which assistance was sought from the medical personnel.

Exposure data for calculating injury rates were gathered from records of bouts actually fought. Injury rates were calculated using the basic rate formula: (number of injuries / number of athlete-exposures) x 1,000 = number of injuries per 1,000 athlete-exposures (A-E).

Mann-Whitney U and Kruskal-Wallis tests were used to determine differences in injury rates between gender and age groups. All analyses were carried out with an $\alpha = 0.05$.

Results

Table 1 shows the total injury rates of young and adult taekwondo athletes. There were significant differences among the male ($p<0.01$) as well as the female ($p<0.05$) groups.

Table 1: Competition injury rates in taekwondo athletes

*A-E: Athlete-exposures

					Injury Rates
	No. of injuries	No. of athletes	No. of A-E*	Per 100 athletes	Per 1,000 A-E*
Boys < 13 years	12	96	180	12.50	66.67
Girls < 13 years	3	22	38	13.64	78.95
Junior Boys	8	43	74	18.61	108.11
Junior Girls	4	21	34	19.05	117.65
Men < 2. kŭp	14	56	100	25.00	140.00
Men ≥ 2. kŭp	4	46	78	8.70	51.28
Women	2	24	42	8.33	47.62

Within the males, the children (< 13 years) had a lower ($p<0.01$) injury rate (66.67/1,000 A-E) than the Juniors (108.11/1,000 A-E) and color belt (<2nd kŭp) Seniors (140.00/1,000 A-E), but a higher rate than the black belt (≥2nd kŭp) Seniors (51.28/1,000 A-E). There were no differences ($p<0.05$) in injury rate between the Junior males and the color and black belt Seniors. There was also no difference ($p < 0.05$) in injury rate between the Senior color and black belt men's groups.

Within the females, the Junior girls (117.65/1,000 A-E) recorded a higher ($p<0.05$) injury rate than the Senior women (47.6/1,000 A-E), but it was not different when compared to that of the children (78.95/1,000 A-E). There was also no difference ($p<0.05$) in injury rate between the children and the Senior women.

Within each age group, the boys had a lower ($p<0.01$) rate than the girls, but there was no difference between the Junior boys and Junior girls. When the children and Juniors are combined, the girls (97.22/1,000 A-E) recorded a higher ($p<0.01$) injury rate than the boys (78.74/1,000 A-E). The women recorded a lower ($p<0.01$) rate than the color belt Senior men. However, it was not statistically different ($p<0.05$) from that of the black belt Senior men. Collapsed over age group, the females (78.95/1,000 A-E) recorded a significantly lower injury rate ($p<0.01$) than the males (87.96/1,000 A-E).

Tables 2a-5b show the distribution of injuries by body part, type, situation and mechanism in young and adult taekwondo athletes, respectively. Due to the small cell sizes, no statistical analyses were attempted to assess which body part was injured most.

Discussion

Elsewhere (Pieter and Zemper, 1997a), no significant difference was found in total injury rate between young male (58.34/1,000 A-E) and female (56.57/1,000 A-E) taekwondo athletes, which is similar to the present findings for Junior boys and girls. However, the previous study had combined the age groups. If this is done for the present investigation, the young females recorded a higher injury rate than their male counterparts, which contradicts the former findings. One reason for this difference may be related to the number of tournaments covered in both studies. Pieter and Zemper (1997a) studied injuries at three tournaments with a total of 3.341 boys and 917 girls participating. The present study, on the other hand, had 139 young male and 43 female competitors.

Table 2a: Distribution of taekwondo injuries by body part in children (<13 years) and junior boys and girls per 1,000 athlete-exposures

	Boys		Girls		Junior Boys		Junior Girls	
Body part	#	Rate	#	Rate	#	Rate	#	Rate
HEAD/NECK	***4***	22.2	-	-	-	-	-	-
Head	1	5.6						
Nose	1	5.6						
Lips	1	5.6						
Throat	1	5.6						
UPER EXTREM.	***1***	5.6	-	-	***1***	13.5	***1***	29.4
Finger(s)	1	5.6					1	29.4
Shoulder					1	13.5		
TRUNK	***1***	5.6	-	-	-	-	-	-
Pelvis/hips	1	5.6						
LOWER EXTREM.	***6***	33.3	***3***	79.0	***7***	94.6	***3***	88.2
Upper leg	1	5.6						
Ankle	1	5.6					1	29.4
Foot	2	11.1	2	52.6	3	40.5	1	29.4
Toes	2	11.1			3	40.5		
Knee			1	26.3	1	13.5	1	29.4
Total	**12**	**66.7**	**3**	**79.0**	**8**	**108.1**	**4**	**117.7**

Table 2b: Distribution of injures by body part in senior taekwondo athletes per 1,000 athlete-exposures

	Men < 2. kŭp		Men ≥ 2. kŭp		Women	
Body part	#	Rate	#	Rate	#	Rate
HEAD/NECK	***6***	60.0	***3***	38.5	***1***	23.8
Nose	4	40.0				
Neck	2	20.0				
Head			1	12.8		
Jaw			2	25.6		
Eye(s)					1	23.8
UPPER EXTREM.	***1***	10.0	***1***	12.8	-	-
Thumb	1	10.0				
Finger(s)			1	12.8		
TRUNK	-	-	-	-	-	-
LOWER EXTREM.	***7***	70.0	-	-	***1***	23.8
Upper leg	1	10.0				
Lower leg	1	10.0				
Knee					1	23.8
Foot instep	2	20.0				
Toes	3	30.0				
Total	**14**	**140.00**	**4**	**51.28**	**2**	**47.62**

Table 3a: Distribution of injures by type of injury in young taekwondo athletes per 1,000 athlete-exposures

	Boys		Girls		Junior Boys		Junior Girls	
Injury type	#	Rate	#	Rate	#	Rate	#	Rate
Abrasion					1	13.5		
Concussion	1	5.6						
Contusion	8	44.4			4	54.1	1	29.4
Epistaxis	1	5.6						
Laceration	1	5.6			2	27.0		
Sprain	1	5.6	3	79.0			3	88.2
Other					1	13.5		
Total	**12**	**66.7**	**3**	**79.0**	**8**	**108.1**	**4**	**117.7**

Table 3b: Distribution of injures by type of injury in senior taekwondo athletes per 1,000 athlete-exposures

	Men < 2. kŭp		Men ≥ 2. kŭp		Women	
Injury type	#	Rate	#	Rate	#	Rate
Blister	2	20.0				
Concussion			1	12.8		
Contusion	5	50.0	2	25.6	1	23.8
Epistaxis	4	40.0				
Internal injury	1	10.0				
Laceration	1	10.0	1	12.8		
Sprain	1	10.0				
Other					1	23.8
Total	**14**	**140.0**	**4**	**51.28**	**2**	**47.62**

Table 4a: Distribution of injuries by situation in children (<13 years) and junior taekwondo athletes per 1,000 athlete-exposures

	Boys		Girls		Junior Boys		Junior Girls	
Situation	#	Rate	#	Rate	#	Rate	#	Rate
Attacking with a kick	*6*	33.3	*3*	79.0	*5*		*3*	
-round kick	5	27.8	3	79.0	3	40.5	2	58.8
-spinning hook kick	1	5.6						
-high/low round kick					1	13.5		
-side kick					1	13.5		
-punch							1	29.4
Unblocked kick	*3*	16.7			*1*	13.5		
- round kick	2	11.1			1	13.5		
- spinning back kick	1	5.6						
Blocking a round kick	*1*	5.6						
Other	*2*	11.1			*2*	27.0	*1*	29.4
Total	**12**	**66.67**	**3**	**78.95**	**8**	**108.11**	**4**	**117.65**

I. R. = Injury rate

Table 4b: Distribution of injuries by situation in senior taekwondo athletes per 1,000 athlete-exposures

	Men < 2. kůp		Men ≥ 2. kůp		Women	
Situation	#	Rate	#	Rate	#	Rate
Unblocked punch	*2*	25.6				
Attacking	*2*	25.6	*7*		*1*	23.8
-round kick	1	12.8	5	50.0	1	23.8
-punch	1	12.8	2	20.0		
Unblocked attack			*6*	60.0		
-round kick			1	10.0		
-spinning hook kick			1	10.0		
-elbow strike			1	10.0		
-punch			3	30.0		
Other			*1*	10.0	*1*	23.8
Total	**4**	**51.28**	**14**	**140.0**	**2**	**47.62**

However, the results of the present study in terms of the higher injury rate for young girls compared to that of their male counterparts agree with those found for adult athletes in other martial sports, whether tested for statistical significance (Blijd et al., 1995) or not (Barrault et al., 1983). Interestingly, the adult females in this study recorded a lower injury rate than their male colleagues. This is similar to what was found at one international tournament where the men (139.54/1,000 A-E) had a higher injury rate than the women (96.49/1,000 A-E), but this difference was not tested for statistical significance (Pieter et al., 1995). It is contrary to results based on multiple tournaments in the U.S.A., where the men (95.07/1,000 A-E) sustained less ($p < 0.05$) injuries than the women (105.45/1,000 A-E) (Pieter, 1995b). It is not entirely clear why these differences between studies exist. One possibility may be related to the number of tournaments covered and number of competitors participating. Another reason may be related to the skill level and experience of the participants. As alluded to above, the athletes included in the present study competed at a lower level and were also not as skilled as the ones our team investigated before (Pieter, 1995; Pieter et al., 1995).

Table 6 displays comparative data on total injury rates in taekwondo and other martial sports based on our own research (Pieter, 1995a; Pieter, 1997; Pieter and De Crée, 1997). All rates refer to those incurred at one tournament in each sport. Since only one tournament was covered each time, it is too early to derive definite conclusions from this comparison. However, it should be noted that the karate tournaments of both the young and adult athletes were of a high standard [(inter)national championships], where only advanced competitors were allowed to compete. The judo tournament, on the other hand, was comparable to that of the taekwondo competition of the present study.

Although no statistical treatment of the data was attempted, visual inspection of Tables 2a and 2b reveals that the lower extremities were injured most, which was also found in some (e.g. Pieter, 1995b; Pieter and Zemper, 1997a), but not all studies on taekwondo injuries (Oler et al., 1991). Since the legs are used more often in taekwondo as opposed to (semi-contact) karate competition, for instance, this should not come as a surprise. In semi-contact karate, the head and neck are most often injured (e.g., Dah and Djessou, 1989; Pieter, 1997; Poirier, 1990). The exact reason for this difference between taekwondo and karate is not clear. More research is needed

Table 5a: Distribution of injures by mechanism in children (<13 years) and junior taekwondo athletes per 1,000 athlete-exposures

	Boys		Girls		Junior Boys		Junior Girls	
Mechanism	#	Rate	#	Rate	#	Rate	#	Rate
Receiving kicks	*4*	27.8			*1*	13.5		
- *round kick*	3	16.7			1	13.5		
- *back kick*	1	5.6						
Simultaneous kicks	*3*	16.7	*1*	26.3			*2*	58.8
- *round/round kick*	2	11.1	1	26.3			1	29.4
- *round/back kick*	1	5.6						
- *round/front kick*							1	29.4
Impact with surface	*2*	11.1					*1*	29.4
Delivering kicks	*1*	5.6	*2*	52.6	*4*	44.0		
- *round kick*	1	5.6	2	52.6	3	40.5		
- *side kick*					1	13.5		
Delivering punch							*1*	29.4
Other	*2*	5.6			*3*	40.5		
Total	**12**	**66.67**	**3**	**78.95**	**8**	**108.11**	**4**	**117.65**

Table 5b: Distribution of injuries by mechanism in senior taekwondo athletes per 1,000 athlete-exposures

	Men < 2nd kŭp		Men ≥ 2nd kŭp		Women	
Mechanism	#	Rate	#	Rate	#	Rate
Receiving punch	3	30.0	2	25.6		
Receiving spinning hook kick	1	10.0				
Receiving round kick	1	10.0				
Receiving elbow strike	1	10.0				
Simultaneous punch			1	12.8		
Simultaneous elbow strike	1	10.0				
Simultaneous round kick		1	12.8	1	23.8	
Delivering punch	1	10.0				
Delivering round kick	5	50.0				
Other	1	10.0			1	23.8
Total	**14**	**140.00**	**4**	**51.28**	**2**	**47.62**

to assess the exact factors that play a role in injuring certain body parts more often over others in both taekwondo and karate.

As was found elsewhere (e.g., Pieter, 1995b; Pieter et al., 1995; Pieter and Zemper, 1997a), the contusion was the most often occurring injury type in taekwondo regardless of sex or age group. The contusion was also sustained most often in other martial sports, such as karate (Pieter, 1997; Pieter, 1995a; Tuominen, 1995) and judo (Dah and Djessou, 1989; Pieter and De Crée, 1997).

Cerebral concussions, however light, are always a cause for concern, although in this small sample they only occurred in the boys (<13years) and in the men ≥ 2nd kŭp (see Tables 3a and 3b). At higher levels of taekwondo competition, the cerebral concussion in adult males can be four times as high as that in American football and in adult females 1.3 times as high when expressed per 1,000 athlete-exposures (Pieter, 1995b). Cerebral concussions in young male taekwondo athletes (<16 years) may be three times as high and in females twice as high as in American football with 16.1% of concussions in boys and 10.9% in girls leading to time-loss (Pieter and Zemper, 1997a; 1997b). Time-loss injury is defined as any circumstance that will keep the athlete from participating in his/her sport for at least one day following the onset of the injury. It is clear that more adequate measures need to be taken to help reduce cerebral concussions in taekwondo competition.

The major injury situation, regardless of age group and experience, was attacking with a round kick (see tables 4a and 4b), which was also found elsewhere (Pieter et al., 1995). The round kick is probably the most often used technique in taekwondo competition (Scheirman, 1985). Reflecting the specifics of each sport, the major injury situation in karate has been found to be attacking with a straight punch in both young and adult athletes (Pieter, 1997; 1998). It is suggested that, from a prevention point of view, athletes consider using other techniques as well, to help reduce the possibility of incurring an injury as a result of the round kick (Pieter, 1995b).

Interestingly, the major mechanisms of injury are simultaneous round kicks and delivering a round kick (see Tables 5a and 5b). Previously, the major injury mechanism for the men was delivering a round kick, and for the women, receiving a round kick (Pieter et al., 1995). In both karate (Stricevic et al., 1983) and taekwondo (Pieter et al., 1995) this technique has led to cerebral concussions. In semi-contact karate, the major injury mechanism for both young and adult athletes was simultaneous straight punches (Pieter 1997; 1998). Preventive measures may include better training in tactical awareness as well as possibly better execution of this kick (Pieter, 1995b). If the athlete is made aware of when it is better or best to use the round kick, or any other technique, chances are that it will be less

Tablica 6: Comparative total injury in taekwondo and other martial sports (based on our own research)

				Injury rates
	No. of injuries	No. of athletes	Per 100 athletes	Per 1,000 ath.-ex
Taekwondo boys < 17 years	20	139	14.39	78.74
Judo boys < 17 years	25	111	22.52	77.16
Karate boys < 17 years	76	218	34.86	99.74
Taekwondo girls < 17 years	7	43	16.28	97.22
Judo girls < 17 years	17	60	28.33	104.94
Karate girls < 17 years	32	84	38.10	115.11
Taekwondo men (< 2nd kŭp)	14	56	25.00	140.00
Taekwondo men (≥ 2nd kŭp)	4	46	8.70	51.28
Judo men	4	29	13.79	51.28
Karate men	86	201	42.79	200.94
Taekwondo women	2	24	8.33	47.62
Judo women	2	8	25.00	125.00
Karate women	40	88	45.46	204.08

involved in an injury as a result of delivering the kick or of simultaneous kicking. In addition, the coach may want to emphasize the athlete's blocking skills in training (Oler et al., 1991, Zemper and Pieter, 1989), so that he or she will not get injured as a result of an unblocked technique as may happen when both competitors perform a technique simultaneously.

Other preventive measures to be considered include educating the athlete and coach alike relative to injury risks (Oler et al., 1991). In addition, modification of the rules which allow kicks to the head (Oler et al., 1991; Tuominen, 1995; Zemper and Pieter, 1989) as well as mandatory use of mats at all levels of competition should be considered (Pieter, 1996). The mats should be of one piece with no folds in the cover (Pieter and Heijmans, 1997) and with plenty of room beyond the ring borders. Referees should have experience as a competitor at the national level as a minimum requirement and should penalize illegal moves immediately (McLatchie et al., 1994).

Conclusions

The injury rates recorded by the young taekwondo athletes are comparable to those of their counterparts in judo and semi-contact karate. The injury rate of the adult female taekwondo athletes is lower than those of their colleagues in judo and semi-contact karate. The rate of the black belt males, on the other hand, was similar to that of judo athletes, but lower than that of semi-contact karate competitors. The beginning taekwondo athletes recorded a similar rate as that of their advanced semi-contact karate colleagues. Differences in competition rules and level of competition experience are among the factors that may have contributed to these differential injury rates.

The major injury mechanism involved the round kick. It is suggested to better train the athlete in game plans (tactics) so that other kicks will also be practiced and used. In some cases, more attention should be paid to technique development and training. A comprehensive program that includes both the athlete, coach and governing body should be developed to help prevent injuries in taekwondo competition.

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