

ASSESS THE INCIDENCE RATE AND SEVERITY OF INJURIES IN 4TH ALEXANDRIA'S INTERNATIONAL OPEN TAEKWONDO CHAMPIONSHIPS

GEHAN Y. ELSAWY¹

Abstract

Purpose. Over the last half century, Taekwondo has evolved to become one of the most popular and commonly practiced martial arts in the world. Which has subsequently led to Taekwondo being included as an official Olympic sport since 2000. The purpose of this study was to assess the injury rates in female adult Egyptian Taekwondo athletes relative to total number of injuries, type and body part injured.

Methods. A prospective recording of the injuries resulting from 83 matches in 4th Alexandria's International Open Taekwondo Championships was performed.

Results. Injuries were recorded, with an incidence of 16.18 injuries per 100 athletes. Occurrence of injuries was higher among lighter categories, the injuries were most commonly located in the hands (20.83%) followed by foot (18.8%), and ankle (16.7%).

Conclusions. Competitive taekwondo is associated with a relatively high injury rate but mainly for minor injuries, with a relative risk lower than in most sports; severe injuries are rare.

Key words: sports injury, taekwondo

Introduction

Taekwondo was originally developed as a fighting art in Korea and subsequently has been distributed all over the world. The competition of Taekwondo is a free-fighting combat sport, using bare hands and feet to repel an opponent. Therefore, the bare hands and kicking technique become significant factors, which have the potential to affect the Taekwondo athlete's performance.

Olympic taekwondo is a modern sport from the second half of the 20th century. Despite its young age, it became an Olympic demonstration sport in 1988 (Seoul) and 1992 (Barcelona) and a full medal contender at the 2000 Sydney Olympic Games. The earliest known epidemiological study on taekwondo injuries was published in 1989 based on the 1988 US Olympic. (E. Gehan , 2002)

Taekwondo is a dynamic form of unarmed self defense that utilizes the entire body, and can be distinguished from other martial arts by its focus on kicking techniques. Snap kicks, a classification of Taekwondo kicks, can be performed quickly and possess the force to break the bones of an opponent.

There is a range of styles of taekwondo in which Participants compete using different sparring rules ranging from non-contact to semi-contact to full-contact.

In 1966, the International TaekwonDo Federation (ITF) was established. Its rules of competition stipulate no contact, while the athletes wear a helmet as well as hand and foot protective gear to help prevent injuries. Sparring bouts last two rounds of 2 min with a 1-min break between rounds for the eliminations and three rounds of 2 min for the finals.

In 1973, the World Taekwondo Federation (WTF) was founded, which follows full-contact competition rules. Matches are for three rounds of 2 min with 1-min breaks in between rounds. Full-contact kicks are allowed to the head and face and designated areas of the body. No punches are permitted to the head and face. (E.Gehan , 2002)

The rules and regulations for Olympic taekwondo competitions, Which are governed by the World Taekwondo Federation (WTF), allow Full-contact sparring using kicking techniques to the head, torso, and punches to the front of the

torso. Players are required to wear protective gear during play, including trunk protector, head protector, groin guard, forearm guards, shin guards, mouthpiece, and gloves. (W.Pieter, et al. 2010)

In addition, according to athletes' safety concerns, the World Taekwondo Federation decreed rules concerning matches, as for example, athletes who participate in Taekwondo should hold "black belt" and should be over 16 years old. In addition, punches were allowed to the front of the torso in the area covered by the chest protector worn by the athletes. Kicks were allowed to the torso and head, which was covered by a helm. Only one point was given from referees for a successful blow. Athletes could win the match by means of a knockout, so contact was encouraged. In 2003 the rules changed and ever since athletes win 2 points for every kick-punch contact on the opponents head and an additional point for an eight-count knockout .

Despite all this, injuries still occur and there is an inherent risk of injury to practitioners of combative taekwondo. The incidence of sport injury usually varies widely depending on many factors, such as level of competition, types of sport, and standard of surveillance systems.

Any injuries may have an impact on the athlete, team, as well as the results depending on frequency, location, and severity of injury. Thus, injury prevention during the events should be one of the fundamental concerns, which may decrease the incidence of injuries among the athletes.

The vast majority of studies on taekwondo injuries deals with acute injuries and almost all of them are concerned with those incurred in competition.

Epidemiologic studies have reported a wide range of injuries for participants in tournaments (M.Feehan, 1995, M. Kazemi, et al. 2005). It seems that findings in the matter of pattern and incidence of injuries in different studies vary according to the interests and popularity of martial arts among the people of the country where the study was performed and the type of data authors used in their studies. Therefore, the picture might be different in Egypt, a country with a relatively big population, where Taekwondo is

¹Assistant professor- Faculty of physical education, Zagazig University, Egypt
Email: amr297@yahoo.com

Received 22.02.2011 / Accepted 16.05.2011

supposed to be the most popular martial art.

To improve training efficiency and extending the life of Athletes, we must understand the location of Taekwondo and the reasons of injury.

Alexandria's international open taekwondo championships is approved by World Taekwondo Federation from 10 to 15 Feb. 2010 in Mubarak Olympic Centre , the Qualification is -Holder of Kukkiwon Dan Certificate (1st Dan or Higher), Introductory letter by the National Taekwondo Association /Federation . the Competition Rules are WTF competition rules for Poomsea and Kyrogi. The Method Of Competition is Single elimination tournamalest system . the Competition Categories are Poomsea - Kyrogi and Age Categories are

Kyrogi:

- Under 12 years old (DOB: 1998-1999]
- Under 14 years old (DOB: 1996-1997)
- Under 17 years old (DOB: 1993-1994-1995)
- Seniors (Male – Female)
Poomsea: (single – pair – group)
- Juniors : (14-17) years old
- Seniors 1 : (18-30) years old
- Seniors 2 : (31-40) years old
- Masters 1: (41-50) years old.
- Masters 2: +50 years old

Although hands and feet can be used in Taekwondo competition game to repel an opponent, athletes prefer to use the kicking techniques rather than hand.

Since taekwondo competitions are currently contested in bouts of 3 rounds of 2 minutes each and since each athlete might have to be engaged in several bouts before reaching the finals, the chances of incurring an injury over the course of each tournamalest is a cause for concern for all involved.

In combat sports, injuries were reported to increase over time in karate competition.(Pieter, et al. 2010)

The purpose of the present study was to provide the frequency, characteristics, and causes of injuries incurred in the competitions during the 4th Alexandria's International Open Taekwondo Championships, Alexandria, Egypt.

Methods

321 Taekwondo player (72 female taekwondo player and 240 male Taekwondo player)From (15) countries (Egypt ,Sudan , India, Syria ,Georgia, Korea, Saudi , Iraq , Emirates ,

Results.

Table 1: numbers of adult athletes in each weight

Weight	-46 kg	-49 kg	-53 kg	-57 kg	-63 kg	-67 kg	-73 kg	73-kg	Total
Female	8	6	13	15	15	6	5	4	72
Weight	-54 kg	-58 kg	-63 kg	-68 kg	-74 kg	-80 kg	-87 kg	87- kg	Total
Male	36	31	42	39	30	22	20	20	240

Is clear from Table 1 that competition in the tournamalest was in 8 weights for males and females, and that the biggest turnout for female was in -53 kg and -57 kg with an average 20.83% in each weight , and the biggest turnout for male was in -63 kg with an average 17.5% .

Table 2 :Injury severity classification

Severe injuries

- Grade III concussions (involving loss of consciousness)
- Fractures excluding clavicular, nasal, digital, metacarpal and metatarsal fractures; but including any fracture
- involving a joint surface or requiring open reduction or internal fixation
- Third degree sprains, or any joint injury likely requiring surgery or expected to result in permanent disabling sequelae
- Dislocated joint requiring manipulative reduction
- Damage to viscera (pneumothorax, acute abdominales, 9
- Major facial laceration with cosmetic or functional sequelae
- Facial bone fracture excluding nasal fractures
- Eye injury likely to cause residual visual loss (globe laceration, hyphema, retinal detachmalest...) or injuries causing damage
- to lid function or lacrimal apparatus
- Any injury requiring hospitalization or surgery, or expected to result in significant functional or cosmetic sequelae

Moderate injuries

- Grade II concussions (involving retrograde and/or antegrade memory loss)
- Clavicular, nasal, digital, metacarpal and metatarsal fractures, but not involving a joint surface or requiring open reduction or internal fixation

Libya , Greece , Sweden, Jordan , Bahrain , Russia) in (8 weights) were participated in The 4th Alexandrians' International Open Taekwondo Championships, which was held in Alexandria governorate in the period from 10th – 15th Feb. Egypt. The competition rules used at all competitions were those of the World Taekwondo Federation (WTF).

For the purposes of this study, an athlete was considered injured if any of the following conditions applied: 1) any circumstance that forced the Taekwondo athlete to leave the competition; 2) any circumstance for which the referee or athlete had to stop competition; 3) any circumstance for which the athlete requested medical attention. In other words, the definition included so-called time-loss injuries (stoppage of a bout) as used in the NCAA Injury Surveillance System. (Colorado Medical Society.1991)

Injury rates were calculated from matches fought using the basic rate formula: (# injuries / # athlete-exposures) × 1,000 = # injuries per 1,000 athlete-exposures (A-E). The Colorado concussion classification was utilized in managemalest of the concussions. According to this classification, a first degree concussion is identified by confusion, no loss of memory and no loss of consciousness (LOC). A second degree involves confusion, loss of memory but no LOC and the third degree is when there is LOC.

The definition of concussion used in the present study is "a traumatically induced physiological disruption of brain function with a short period of altered or loss of consciousness" (The Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine, 1993). The case definition of potential concussion includes any athlete who has had a direct blow (blunt trauma by a kick) to the head/face region which may induce physiological disruption of brain function. They must have experienced at least one of the following: any period of loss of consciousness (30 minutes or less); any loss of memory for events immediately before or after the injury (posttraumatic amnesia not greater than 24 hours); any alteration in malest state at the time of the injury (e.g., feeling dazed, disoriented, or confused); focal neurological deficit(s) that may or may not be transient. When the impact caused facial/skull fractures, the case was excluded from this study.

- Dental injury with tooth loss or requiring restorative procedures
- Corneal abrasions acutely affecting vision
- Laceration requiring stitches
- Joint dislocation that self-reduces at the ring
- Contusion, sprain or haematoma preventing use of the limb on the day of competition

Minor injuries

- Grade I concussion (the athlete is briefly stunned and confused, regaining full faculty within a few minutes)
- Contusion of solar plexus
- Epistaxis without a fracture
- All other injuries not listed above, and generally not requiring removal from the match or further medical care

Table 3: Injury rates (95%CI) in adult Taekwondo athletes.

Injury rates	Male	Female	Total
Number of athletes	240	72	321
Number of reported injuries	41	11	76
Number of athlete-exposures (AE)	480	144	624
Injury rates			
per 100 athletes	17.08	15.28	16.18
per 1,000 AE	85.42	76.39	80.91

Is clear from Table 3 that Injury rates (95%CI) per 100 athletes in males was 17.08 and females 15.28. per 1,000 AE in males was 85.42 and females 76.39.

Table 4: Distribution of injuries by body part per 1,000 athlete-exposures.

Body part	Male		Female	
	Number	Rate	Number	Rate
Head	2	4.2	3	20.83
Nose	1	2.1	-	-
Hands	10	20.83	5	34.72
Upper back	2	4.2	-	-
Low back	1	2.1	-	-
Hamstrings	-	-	2	13.9
Leg	4	8.33	-	-
Ankle	8	16.7	-	-
Foot	9	18.8	1	6.94
Toes	3	6.3	-	-
Total	41	85.42	11	76.39

Is clear from Table 4 that distribution of injuries by body part per 1,000 athlete-exposures in males was Hands (20.83) , Foot (18.8) , Ankle (16.7) , Leg (8.33) , Toes (6.3) , Head and Upper back (4.2) , Nose and Low back (2.1) , followed by no injuries in Hamstrings , and distribution of injuries by body part per 1,000 athlete-exposures in females was Hands (34.72), Head(20.83), Hamstrings(13.9) , Foot (6.94) followed by no injuries in Nose, Upper back, Low back, Leg, Ankle and Toes.

Table 5: Distribution of injuries by Nature of Injury per 1,000 athlete-exposures.

Nature of Injury	Male		Female	
	Number	Rate	Number	Rate
Fracture	2	4.2	3	20.83
Sprain/Strain	35	72.92	7	48.61
Open Wound	4	8.33	1	6.94
Total	41	85.42	11	76.39

Is clear from Table 5 that distribution of injuries by Nature of Injury per 1,000 athlete-exposures in males was Sprain/Strain (72.92), Open Wound (8.33) and Fracture (4.2) , and the distribution of injuries by Nature of Injury per 1,000 athlete-exposures in females was Sprain/Strain (48.61), Fracture (20.83) and Open Wound (6.94).

Table 6: Distribution of injuries by Severity of Injury per 1,000 athlete-exposures.

Severity of Injury	Male		Female	
	Number	Rate	Number	Rate
Severe	5	10.42	2	13.9
Mild	6	12.50	4	27.78
Minor	30	62.50	5	34.72
Total	41	85.42	11	76.39

Is clear from Table 6 that distribution of injuries by Severity of Injury per 1,000 athlete-exposures in males was Minor (62.50), Mild (12.50) followed by Severe (10.42) , and the distribution of injuries by Severity of Injury per 1,000 athlete-exposures in females was Minor (34.72), Mild (27.78) followed by Severe (13.9).

Table 7: Distribution of injuries by Cause/Mechanism of Injury per 1,000 athlete-exposures.

Cause/Mechanism of Injury	Male		Female	
	Number	Rate	Number	Rate
Fall/Throw/Jump	15	31.25	3	20.83
Foot Strike/Kick	11	22.92	2	13.89
Hand Strike/Punch	9	18.8	1	6.94
Block	6	12.5	5	34.72
Total	41	85.42	11	76.39

Is clear from Table 7 that distribution of injuries by Cause/Mechanism of Injury per 1,000 athlete-exposures in males was Fall/Throw/Jump (31.25), Foot Strike/Kick (22.92), Hand Strike/Punch (18.8), followed by Block (12.5). and the distribution of injuries by Cause/Mechanism of Injury

per 1,000 athlete-exposures in females was Block (34.72), Fall/Throw/Jump (20.83), Foot Strike/Kick (13.89), followed by Hand Strike/Punch (6.94).

Table 8: Distribution of head blows and concussions by the kicking techniques

Techniques	Frequency of head blow without concussion (%)		Frequency of concussion (%)	
	Male	Female	Male	Female
Roundhouse kick	10	3	8	3
Axe kick	9	1	3	1
Spinning kick	4	2	2	0
Back kick	2	0	1	1
other	1	0	1	0

Is clear from Table 8 that Frequency of head blow without concussion (%) in male was Roundhouse kick (10%), Axe kick (9%) , Spinning kick (4%), Back kick (2%) and other (1%) , and the Frequency of head blow without concussion (%) in female was Roundhouse kick (3%), Spinning kick (2%), Axe kick (1%) . the Frequency of concussion (%)in male was Roundhouse kick (8%), Axe kick (3%) , Spinning kick (2%), Back kick (1%) and other (1%), and the Frequency of concussion (%)in female was Roundhouse kick (3%), Axe kick (1%) , Back kick (1%).

Discussion and conclusion

Injury rates

Based on the results of this study the Injury rates (95%CI) per 100 athletes in male was 17.08 and female was 15.28. adding to per 1,000 AE in male was 85.42 and female was 76.39. there is no difference between gender in injury rates.

T.Braun (1999) covered full-contact taekwondo at a World Cup and one German national championship. The national tournament also included junior participants.

Collapsed over gender, the athletes at the World Cup sustained 95.52 injuries per 1,000 athlete-exposures (A-E). Most injuries were contusions: 74.63/1,000 A-E.

One athlete-exposure refers to one individual competing in a bout where he/she is exposed to the possibility of being injured.

Injury rates collapsed over gender were also reported by (Phillips et al. 2001): 86.59/1,000 A-E for African taekwondo-in . Sprains/strains were the most often occurring injury type (47.49/1,000 A-E), followed by contusions (27.93/1,000A-E). The lower extremities were the most often injured body region (61.3% of total), followed by the upper extremities (32.3%).

Injuries by body part

Based on the results of this study the injuries by body part per 1,000 athlete-exposures in males was Hands (20.83) , Foot (18.8) , Ankle (16.7) , Leg (8.33) , Toes (6.3) , Head and Upper back (4.2) , Nose and Low back (2.1) , followed by no injuries in Hamstrings , and distribution of injuries by body part per 1,000 athlete-exposures in female was Hands (34.72), Head(20.83), Hamstrings(13.9) , Foot (6.94) followed by no injuries in Nose, Upper back, Low back, Leg, Ankle and Toes.

Because Punches and/or blocks in Taekwondo can lead to finger, knuckle, hand and wrist injuries.

Past studies have reported several types of injuries to the hand and face: contusion, laceration, facial fracture, dislocation and concussion. Among these injuries, there is a growing concern with respect to concussions due to its potentially detrimalest effects. However, the back and sidekicks can generate large chest compressions and thus may have more potential for skeletal injury when contact is made with the body of the opponent. In particular, blows to the head region occur commonly in Taekwondo competitions since the face is a major scoring region (W.Pieter & R. Lufting,1994; W.Pieter & ED.Zemper,1998;W.Pieter & ED. JE. Zemper,1999; P. Siana, H. Borum & Kryger ,1986). Thus, it's necessary for prudent rule changes in competition to be considered and for athletes to train and understand how to prevent possible head injuries due to a direct blow to the head.

Nature of Injury

Based on the results of this study Nature of Injury per 1,000 athlete-exposures in males was Sprain/Strain (72.92), Open Wound (8.33) and Fracture (4.2) , and the distribution of injuries by Nature of Injury per 1,000 athlete-exposures in female was Sprain/Strain (48.61), Fracture (20.83) and Open Wound (6.94).

Sprain is an injury on internal organs without any damage to the skin by the impact of a strong external force. Muscular sprain entails the destruction of capillary vessel and hemorrhage, producing a bruise and a swell. Sometimes, it accompanies a strong fever around the infected part

Strain is meant by the state of muscle tissue which is partially cut off or split due to excessive extension of muscle, fascia, ligament, tendon, etc. It is usually caused by the impact of external force when a maximum exertion of force is attempted without sufficient warming up. Sometimes symptoms of adiabatic muscle or adiabatic tendon are brought about. In a state of strain, the destruction of capillary vessel produces hematoma which gives much pain and disables the motional function.

Strain-infected muscle or tendon is more likely, if cured one, to relapse, which discourages a player to exert his maximum physical ability.

Ankle sprains are the most common sports injury. (T.E.J.R.Lassiter, et al.1989; D.MacAuley D. 1999). It is projected that one ankle sprain occurs for every 10,000 people per day. (TEJ.R. Lassiter, et al.1989; ED. Zeegers,1995; SC. Brooks, et al. 1981). The ankle is defined as the region of transition from the leg to the foot and contains the ankle joint. (MJ.Boytim , et al. 1991) The ankle region includes three articulations: the inferior tibiofibular joint, the talocrural joint and the subtalar joint. (N.Lauge-Hansen N. 1950)

Full-contact taekwondo was also part of a study on injuries at a multi-sport tournament (Cunningham C & Cunningham S. 1996) . Although no injury rates by gender were provided, the results indicated that 66.3% of all those who participated in taekwondo incurred an injury. The most often occurring injuries were contusions (56% of total injuries) and sprains (26%).

Some studies were conducted on full-contact taekwondo injuries without reporting injury rates by gender. For instance, reported that of approximately 700 adult competitors, 41 presented to the first aid station at a national tournament in the USA incurring a total of 52 injuries. Most injuries were sustained to the head and neck (49% of total) followed by the lower (23%) and upper extremities (21%).

Severity of Injury

Severity of Injury per 1,000 athlete-exposures in males was Minor (62.50), Mild (12.50) followed by Severe (10.42) , and the distribution of injuries by Severity of Injury

per 1,000 athlete-exposures in female was Minor (34.72), Mild (27.78) followed by Severe (13.9).

It is hypothesized that injuries would increase with age in taekwondo as the athletes are expected to increase in body weight and strength (W. Pieter W& ED. Zemper ED.1997). However, this assumption was not analyzed for statistical significance. Later prospective studies showed either no statistically different ($p \geq 0.05$) or a lower injury rate with age ($p \leq 0.001$) (Pieter W& Kazemi M. 2002) but also a higher one ($p \leq 0.001$). Middle school taekwondo athletes were more likely to incur a cerebral concussion in competition compared to high school counterparts (OR =1.89) [35].

Cause/Mechanism of Injury

Cause/Mechanism of Injury per 1,000 athlete-exposures in males was Fall/Throw/Jump (31.25), Foot Strike/Kick (22.92), Hand Strike/Punch (18.8), followed by Block (12.5). and the distribution of injuries by Cause/Mechanism of Injury per 1,000 athlete-exposures in males was Block (34.72), Fall/Throw/Jump (20.83), Foot Strike/Kick (13.89), followed by Hand Strike/Punch (6.94).

This usually happens in high-jumping. However, it occurs in Taekwondo too, when at the moment of delivering a jumping kick, a sudden turning of the body with a leg opened apart gives an excessive impact on the muscle connecting the pelvis and the thighbone. In this case, the injury occurs deep inside the muscle so that any adhesive plaster is not effective. Only a deep heat treatment is applicable and a complete cure takes several weeks.

Head blows and concussions

There is an inherent risk of injury for practitioners of taekwondo, as with any contact sport. In a recent meta-analysis of injuries among taekwondo participants in 15 tournaments, (Lystad, et al. 2009) reported an overall mean injury rate of 79.3 per 1000, or 8%. Head trauma is one of the most common injuries in both males and females receiving a blow during taekwondo matches. However, most head injuries and cerebral concussions are mild; serious head injuries are considered rare events under modern taekwondo rules. The frequency of head injuries has declined since introduction of a rule requiring participants to wear protective helmets during fights.

It has been noted that Senior taekwondo athletes can generate velocities of 13-16 m/s during the roundhouse kick, a circular kick most frequently used in competition. The Junior girls who participated in the First Junior Taekwondo World Championships recorded a mean velocity of 12 m/s (range: 9-14.5 m/s) for the roundhouse kick, and the boys 14.7 m/s (range: 12-19.6 m/s). It was estimated that a punch velocity of 8 m/s would result in a peak acceleration of the head of about 200 g, assuming there is no deflection during the punch. Head accelerations of 80 g are hypothesized to cause concussion in adults (P.K., Smith, & Hamill, J., 1986). It is readily apparent that the velocities generated by even the Junior taekwondo athletes during kicking are more than sufficient to result in cerebral concussion in adults.

In 2001, (K.Beis, et al.) reported taekwondo injuries in relation to time of competition, while (V.Ziaeet al.2010) suggested that most injuries were sustained in the third round of a match.

Fatigue is suggested to be at the basis of this finding (R. Tuominen,1995)

ED.Zemper and W.Pieter (1994) reported that the rate of concussion for Taekwondo is 3 times higher than in college football games, based on number of exposures, and nearly 8 times as high based on time of exposure. In addition, the frequency of concussions seems to have increased since

mandatory usage of headgear became required in competition Taekwondo (i.e., since 1985). Cases of concussion reported during World.

Future research should consider taking into account the time of injury occurrence, which in turn may lead to improved preventive measures, such as better conditioning of the athletes (HH.Wang, et al.2005) or changing competition tactics.

References

- BEIS, K., PIETER, W., ABATZIDES, G., 2001.** *Match characteristics and taekwondo injuries.* In: Jürimäe T, Jürimäe J (eds). Proceedings of the 7th International Scientific Conference of the International Association of Sport Kinetics. Acta Kinesiologiae Universitatis Tartuensis.; Pp:77-80.
- BOYTIM, MJ., FISCHER ,DA., NEUMANN, L., 1991.** *Syndesmotic ankle sprains.* Am J Sports Med; 19:294-8.
- BRAUN, T .,1999.** *Verletzungen bei hochklassigen Taekwondo-Turnieren – eine Standortbestimmung .* Deut Zeit Sportmed ; 50 (7 + 8): 239 – 242 .
- BROOKS, SC., POTTER, BT., RAINES, JB. 1981.** *Treatment for partial tears of the lateral ligament of the ankle: a prospective trial.* Br Med J (Clin Res Ed);282:606-7.
- COLORADO MEDICAL SOCIETY. REPORT OF THE SPORTS MEDICINE COMMITTEE, 1991.** *Guidelines for the Management of Concussion in Sports* (revised) Denver, Colorado Medical Society.
- FEEHAN, M., WALLER, AE. 1995.** *Pre-competition injury and subsequent tournament performance in full-contact taekwondo.* Br J Sports Med. 29:258-62.
- GEHAN, E., 2002.** *Common injuries among female taekwondo players, educational researches journal.* Zagazig university , (1) 32-49
- KAZEMI, M., SHEARER H., CHOUNG YS., 2005.** *Pre-competition habits and injuries in Taekwondo athletes.* BMC Musculoskeletal Disorders;6.
- KELLY, JP., ROSENBERG, JH., 1998.** *The developments of guidelines for the management of concussion in sports.* J Head Trauma Rehab, 13(2):53-65.
- LASSITER, TE JR, MALONE TR, GARRETT, WE. JR., 1989.** *Injury to the lateral ligaments of the ankle.* Orthop Clin North Am ;20:629-40.
- LAUGE-HANSEN, N. 1950.** *Fractures of the ankle, II: combined experimental surgical and experimental roentgenologic investigation.* Arch Surg;60:957-85
- LINDENFELD, TN, SCHMITT DJ, HENDY MP, MANGINE RE, NOYES, F.,1994.** *Incidence of injury in indoor soccer.* Am J Sports Med;22(3):364-371.
- MACAULEY, D., 1999.** *Ankle injuries: same joint, different sports.* Med Sci Sports Exerc ;31:409-11.
- MCKEAG, DB., HOUGH DO, ZEMPER ED,, 1993.** *Primary Care Sports Medicine.* Dubuque, IA: Brown & Benchmark;63-73.
- MOHSEN, KAZEMI AND WILLY PIETER, 2004.** *Injuries at a Canadian National Taekwondo Championships: a prospective study,* BMC Musculoskeletal Disorders, 5:22
- PHILLIPS, JS , FRANTZ JM , AMOSUN SL , WEITZ W ,2001.** *Injury surveillance in taekwondo and judo during physiotherapy coverage of the Seventh All Africa Games .* S A J Physiotherapy. 57 (1) : 32 – 34.
- PIETER, W., & LUFTING, R., 1994.** *Injuries at the 1991 Tae-kwon-do World Championships.* Journal Sports Trauma Real Research ,16,49-57.
- PIETER, W., & ZEMPER ,ED.(1998).** *Incidence of reported cerebral concussion in adult Taekwondo athletes.* J Roy Soc Health ,118,272-279.
- PIETER, W., ROSTAMI, M. AND ZIAEE V.,2010.** *Injury Rates in Iranian Taekwondo Athletes; a Prospective Study,* Asian Journal of Sports Medicine, Volume 1 (Number 2), June, Pages: 117-121
- PIETER, W., ZEMPER ,ED., 1999.** *Head and neck injuries in young Tae-kwon-do athletes.* J Sports Med Phys Fitness,39,147-53.

- SERINAL, E. R. & LIEU, D. K. 1991. *Thoracic injury potential of basic competition Taekwondo kicks*. Journal of Biomechanics, 24, 951-960.
- SIANA, J.E., BORUM, P., & KRYGER, H. 1986. *Injuries in Taekwon-do*. British Journal of Sports Medicine, 20, 165-6.
- TUOMINEN R. (1995). *Injuries in national karate competitions in Finland*. Scand J Med Sci Sports, 5:44-8.
- WANG HH, LIU C, CHU MY ET AL. 2005. *Effects of passive repeated plyometric training on specific kicking performance of elite Olympic taekwondo player (sic)*,
- ISB XXth Congress - ASB 29th Annual Meeting. Cleveland, USA, July 31 - August 5.
- ZEEGERS AV CM., 1995. *Supination injury of the ankle*. Thesis, University Utrecht.
- ZEMPER, E. D. & PIETER, W., 1994. *Cerebral concussions in Taekwondo athletes*. In: Hoerner, E. F. (Ed). *Head and Neck Injuries in Sports* (pp. 116-123). Philadelphia: American Society for Testing and Materials.
- ZIAEE V, RAHMANI SH, ROSTAMI M., 2010, *Injury rates in Iranian taekwondo athletes; a prospective study*. Asian J Sports Med, 1:23-28.