Injury Profiles and Concerns for Future Martial Artists

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Introduction

The world of martial arts has seen increasing popularity especially over the last three decades and has established organizations within many countries. This paper will examine combative martial arts injuries in comparison to popular sports, identify martial arts injury profiles according to style, and offer improvements to increase safety and decrease risk. As many martial arts have a reputation for having high injury rates, organizations have developed rules and regulations to decrease significant risk. Taekwondo and karate are two of the main styles followed across the world, along with Muay Thai and mixed martial arts, which are also increasing in practice.

Previously, much of the research analyzes specific injuries that have occurred in martial arts and are pilot studies that should be further supported. Additionally, many of the groups studied are of national-level or highly experienced competitors. Though this research yields very important data, it may not be accurate for most people who practice martial arts. In an attempt to better understand this expanding activity, researchers in many different countries have increasingly begun analyzing and publishing papers these last ten years. Nonetheless, studies need to be conducted because the practice of martial arts and

competition are evolving, and it is important to evaluate injury risk with its current rules. At this point in time, it is better to understand martial arts as it is practiced now, recognize main styles and their injury profiles, and recognize its place among sports and as an art with philosophy and discipline.

Research

Martial Arts in Comparison to Sports

Currently, there are few studies comparing martial arts injuries directly with other sports. One of largest of these studies, performed by Urho Kujala, et al, and published in 1995 in the *British Medical Journal*, provides analysis of national sports injury insurance data collected in Finland during 1987 to 1991 covering 621,691 person-years of sports exposure.[1]

Kujala and associates compared participants in soccer, ice hockey, volleyball, basketball, judo, and karate. They found that each sport has a specific injury profile, with higher injury rates in sports that had more powerful and frequent body contact such as ice hockey and karate. In soccer, volleyball, and basketball, most injuries were to the lower limb while judo had more injuries in the upper limbs. Judo and karate practitioners experienced more dislocations than other athletes, and while judo had more upper limb injuries, karate and ice hockey had more dental injuries. Across all activities, sprains, strains, and bruises were the most common types of injury. During the ten-year timespan of the study, numerically there were fewer injuries in judo and karate; however, judo

and karate also had fewer exposure-years. Thus, the rate of injury for these martial arts is calculated to be 23% higher in judo and 48% in higher karate than that of ice hockey. Mouth guards were recommended for karate, ice hockey, and basketball due to dental injuries in these sports.

Taekwondo and Related Pediatric Studies

In 1997, Mohsen Kazemi and Willy Pieter directed an injury study on athletes (219 males, 99 females) participating at the Canadian National Taekwondo Championships.[2] All injuries were recorded on a standardized incident form to document each injury and subsequent treatment (if any) provided by the tournament health care team.

Males sustained significantly more injuries than the females, experiencing an injury rate of 79.0/1,000 injuries/athlete-exposures compared with only 25.3/1,000 for women. The lower extremities were the most commonly injured body region in the men, followed by the head and neck; however, all injuries to women occurred in the lower extremities with their most common type of injury being the contusion. In comparison, the men's most common type of injury was the sprain. This difference in injuries may imply differences between male and female competitors and their fighting techniques.

Together with Eric Zemper, Pieter published a second paper in 1997, this one focused on injuries sustained during junior taekwondo competitions.[3] Pieter used check-off forms that describe the athlete, nature, site, and circumstances of tournament injuries sustained by 3,341 boys and 917 girls. They found that

there were no statistical differences in total injury rate between boys and girls. As with the first study, the data showed that the highest injury rates were to the lower extremities and that unblocked attacks are the primary cause of injury in both boys and girls. Thus, the researchers suggest that coaches work on the avoidance and blocking skills of their junior taekwondo athletes in order to protect the head.

The third paper discussed in this section was published in 2005 by Mohsen Kazemi, Heather Shearer, and Young Su Choung. This retrospective study utilized a survey of precompetition habits and training for Canadian taekwondo athletes competing in a national tournament.[4] This study looked at dieting and weight cycling in addition to training, injury profiles, and social support. Questionnaires were distributed to 60 athletes, of whom 28 replied. While injury and training aspects are examined, however, as only 24 competitors' surveys were used in the injury statistics, the pilot study conclusions should be considered descriptively rather than numerically.

Although the data set was limited, lower limb injuries again predominated (64.4%), followed by injuries to the upper extremities (20.0%), back (13.3%), and head (2.2%)—similar to the injuries found in the junior competitors of Pieter's study. Most of the injuries consisted of sprains/strains, followed by contusions, fractures, and concussions—similar to Kazemi and Pieter's study. Another important aspect is that injury did not have an association with fight outcome, perhaps because those with severe injuries did not compete further, while those incurring minor injuries were not impaired enough to affect performance.

Karate and Muay Thai

Karate is often thought of a sport with higher risk of sports injury, similar to taekwondo. In order to decrease injury rates, the World Karate Federation in 2000 has changed safety, equipment, and scoring rules. In a study by Jelena Macan, Danijela Bundalo-Vrbanac and Goran Romic, published in 2006, researchers compared the incidence and distribution of injuries in noncontact karate in 1997 and 2002 to observe the effects of the new rules in Croatia.[5] These rule changes prohibit excessive force in delivering blows, blows to the face with open hand techniques, and dangerous throwing techniques. The rule changes also redistribute more points to kicking techniques. This study used a questionnaire to evaluate a total of 2023.5 and 2584 minutes of active fighting (exposure time) for 1997 and 2002 competitors, respectively. Analysis of this data shows that adoption of the new rules resulted in a decrease to the overall relative risk of injury in competitors under 18 years old. Additionally, there are fewer injuries to the head and more injuries to the legs, due in part to the point redistribution. This study concluded that the new rules are very important in the distribution and prevention of injuries in martial arts. These karate competitions were specifically for noncontact/light contact fighting and thus, strict judging and heavy penalties for uncontrolled (excessive) blows significantly decreased the risk of injury.

In 2001, Sam Gartland, Mohammad Hammad 'Hammy' M.A. Malik, and Martyn E. Lovell published a study conducted on Muay Thai kick boxing participants in order to compare the type and number of injuries that occur during the training and practice of Muay

Thai to the data obtained with those from previous studies of karate and taekwondo.[6] They collected data by conducting one-to-one interviews using a standardized questionnaire regarding injuries during training and practice of Muay Thai at various gyms and competitions in both the United Kingdom and a Muay Thai gala in Holland. They studied 132 men and 20 women, of whom 19 were beginners, 82 amateurs, and 51 professionals.

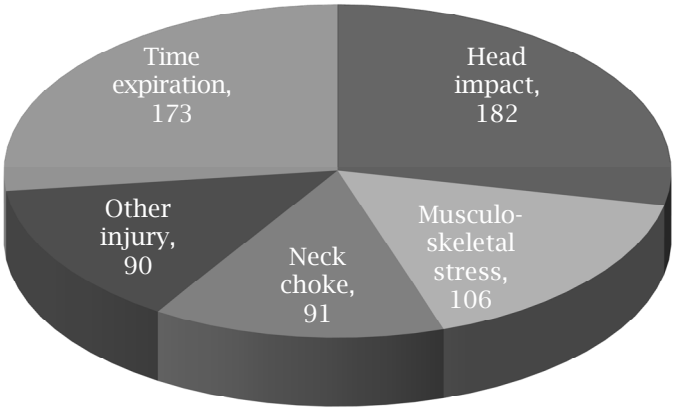
Injuries to the lower extremities were the most common in all groups and head injuries were the second most common in professionals and amateurs; beginners are not allowed to make head contact in sparring. Soft tissue trauma was the most common type of injury in the three groups. Injury rates were higher in beginners, at 13.5/1000 participants; amateurs had an injury rate of 2.43/1000 participants and professionals, 2.79/1000 participants. The authors concluded that Muay Thai injury rates are similar to those found for karate and taekwondo although they also found that Muay Thai practitioners experienced a lower percentage of severe injuries that required time off from training compared to the other combative arts.

Mixed Martial Arts Injuries

Modern mixed martial arts (MMA) competitions between combatants trained in diverse martial arts began in the early 1990's, via Shooto competitions in Japan (beginning in 1989), and the Ultimate Fighting Championship (1993) in the United States. Initial competitions tended to lack rules regarding protective gear, weight classes, time limits, or other regulatory standards common to other combat sports.[7] This

initial phase was promoted as "no holds barred sports fighting." Though no deaths or permanently disabling injuries have been reported in the US, widespread criticism and safety concerns led to creation of the International Sport Combat Federation (ICSF) in May of 1999, with instatement of rules and regulations codified in 2000—the same year as new regulations in karate and three years before taekwondo point redistribution.[8] In 2005, George Buse published a study in the British Journal of Sports Medicine on MMA to identify the medical issues associated with mixed martial arts competition by reviewing public video footage of 1,284 men competing in 642 televised matches from 1993 to 2003.[9]

Figure 1: Data for MMA Fight Conclusions (Buse).



Buse found that of these matches, 28.3% were stopped due to head impact, 16.5% because of musculoskeletal stress, 14.2% because of neck choke, and 26.7% because of expiration of match time (see Figure 1 above). Because this study showed that the

largest fraction of the matches ended with blunt forces to the head, Buse suggests that further research is needed to explore how morbidity is associated with participation in mixed martial arts.

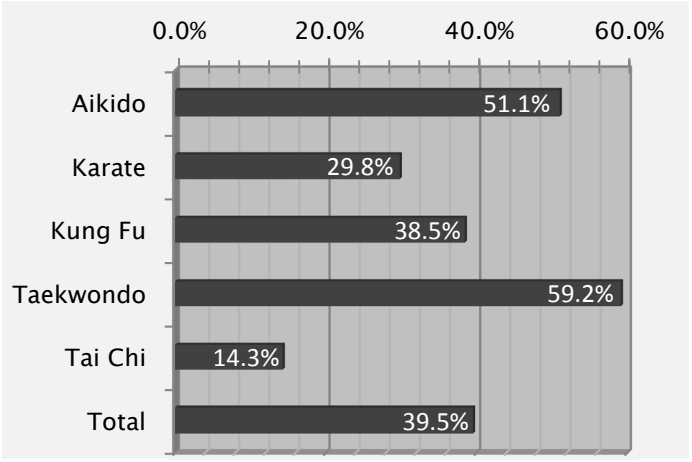
In 2008, Ka Ming Ngai and colleagues published a retrospective cohort study to examine mixed martial arts injuries during March 2002 to September 2007, involving 1,270 fight participants and 635 professional MMA matches.[10] Take note that Buse's study largely takes part before regulations were instated and Ngai's study slightly overlaps in time with Buse's study when additional safety rules have been implemented. Ngai's results show increasing numbers of participants since 2002, with the losers sustaining 2.53 times as many injuries as winners.

Ngai found that the most common injuries reported were lacerations (17.3%) and upper extremity injuries (ocular, facial, and upper limbs: 26.1%) attributed mainly to strikes. This paper documented 23.5 injuries per 100 fight participants and a concussion rate of 15.4 per 1,000 athlete exposures or 3% of all matches, which they noted is similar to risk of concussion in international men's taekwondo competition. Their conclusion is that injury rates in the regulated professional MMA competitions are similar to other combat sports and the overall risk of critical injury appears low. They noted that the age, weight, and fight experience of the martial artists did not significantly increase the likelihood of injuries when controlled for other covariates—though they do not identify these covariates.

Comparisons Within Martial Arts Styles and Other Implications

Currently, there are few studies that compare multiple martial arts against one another. In 2005, Merrilee N. Zetaruk, et al, published a study comparing five martial arts with respect to injury outcomes over a one year retrospective cohort via an injury survey.[11] Their study polled 263 martial artists: 47 in aikido, 114 in Shotokan karate, 39 in kung fu, 49 in taekwondo, and 14 in tai chi.

Figure 2: Injury Reports by Martial Arts Style (Zetaruk).



They found the rate of injuries varied according to style (see Figure 2 above) and that taekwondo had a significantly greater risk of injury than Karate.

Compared with karate, the risks of head/neck injury, upper extremity injury, and soft tissue injury were all relatively higher in aikido, and the risks of head/neck, groin, and upper and lower extremity injuries were higher in taekwondo. Zetaruck concluded that taekwondo participants have higher

relative injury risk than those in karate and that different martial arts have significantly different types and distribution of injuries.

Aside from pediatric studies involving martial arts, other studies have been done involving the elderly and how martial arts may benefit this age group. In 2007, Roos van Swigchem, Brenda Groen, and others published a paper on how falling techniques may decrease impact upon the hip and whether people can apply these techniques in real life.[12] Because it is unethical to push subjects such as an elderly woman and time her fall, they have used five seasoned judokas and nine non-judokas to perform voluntary falls. They found that voluntary motor control is possible within a specific time window (about 145–155 msec from a kneeling height) in the fall, even in inexperienced fallers. This is important because falling is the leading cause of injury-related death in adulthood.[13] The authors conclude by suggesting that more studies should be done to expand on these results. Of particular caution against making premature conclusions, they noted lack of the "startle-adrenaline" effect (since the falls were premeditated), and possible errors due to the small sample size and the fact that the test subjects were young women rather than more elderly subjects.

Discussion

Upon analyzing these studies, it becomes clear that while many studies agree upon certain aspects, some studies do not show similar results. An important concern of all the studies involves underreporting

injuries which leads to underestimates of injury rate. This may be due to participants' uncertainty about what constitutes an injury, low recall on past injuries, unreported injuries to trainers in order to compete, or self-treated injuries. Some of the important issues include gender differences in injury profiles, age of participants, and equipment.

In the taekwondo studies, the junior competitions[14] showed no statistical differences between males and females while the study of adult Canadian national competitors[15] showed an obvious difference in injury profile. One explanation for this discrepancy might be that the training and body strength of younger Taekwondo practitioners does not differ as greatly between genders as in adult competitors. This may reflect upon the trainers and training methods, though the studies do not record how many trainers a competitor usually has. Additionally, the studies stated that even though helmets are worn, many of the taekwondo blows to the head were unblocked, hence reducing the incidence of concussions remains a safety concern in taekwondo competition. Many groups suggest that head contact should not be permitted in competition, others argue for better teaching of avoidance and blocking skills. Following implementation of new karate regulations, the number of head injuries decreased due to enforcement of stricter rules and a reconstituted point-scoring system. Perhaps this idea should be instated for younger taekwondo competitors as well.

As seen by Kujala's study, injury rates are low in younger athletes and highest in young adults. Many of the other studies have shown this difference in injury

rate among ages as well, though they differ in their age categories such as 18 or older[16] or 20 to 24.[17] Some studies instead choose to view experience differences by categorizing them into beginners or years of experience. Overall, it is shown that younger athletes have lower injury rates, probably due to regulations that promote safety and careful training as well as due to the fact that with smaller body sizes, children may not overcome the strength threshold needed to injure their opponents via kicks and strikes. Body factors may also have a role in the gender differences reported by some studies.

In contrast to taekwondo, beginners in Muay Thai suffered more injuries,[18] though these were more likely to be contusions followed by sprain/strain as compared to the more severe injuries (fractures) seen in professional competitors. Many studies observed that different training methods/regulations are given according to age, rank, and experience and that these elements play an important role in reducing injury risk. Similarly, the fact that many MMA competitors have multiple years in experience in different styles may decrease the age- or weight-related injury risk factors for those athletes.[19]

While most of the studies surveyed here focused on a certain set of competitors such as taekwondo nationalists or experienced mixed martial artists, these injury profiles are indicative only of the extreme end of participation—hence the applicability of the study conclusions might be limited to those of elite competitors who enter competition tournaments.

Some studies took note that with lower hours trained per week[20] and differing competition style,[21]

there were statistically lower injury rates—this may be in part due to exposure and type of competition, but also has a confounding factor of personality. If a person enjoys him or herself and finds excitement in training and sparring, it is likely he or she will train more hours with enthusiasm—which may lead to larger risk of injury. As seen with the national-level taekwondo competitors,[22] some athletes continue to train despite injury; such training may then exacerbate those injuries and leads to higher risk of subsequent damage.

Overall, injury rates are higher in combative martial arts due to the nature of a sport which involves body contact with the opponents. Thus, many studies expressed concern with preventative measures such as teaching taekwondo competitors to block[23] or instatement of changes regarding protective gear.[24] They remarked that for much of the gear it was more protective for the attacker than the defender, such as instep guards and gloves that do not slow down the acceleration of the punch or decrease force. In the pediatrics study,[25] weight has a positive correlation with injury and helmets were more beneficial to prevent injuries if the competitor hit the ground. From personal martial arts experience, it is hard to tell whether heavier padding is favorable due to increased protection or if believing there is increased protection leads to harder strikes. Though many competitions have regulations regarding equipment, it would be beneficial to design gear specific to martial arts style to decrease injury rates.

Conclusion

Martial arts involving contact competition have higher injury rates than other sports involving body contact. Additionally, competitions are held between pairs and during the match, the attacker may be injured as well as the defender—as seen by the relatively high rate of lower limb injuries in taekwondo despite the fact that strikes directed below the waist are illegal. Although martial arts are not team competitions in the ring, Kazemi studied the psychological effect of social support. That area should be studied in further research to observe its effects upon athletes. Furthermore as various martial arts styles tend to have different injury profiles, individuals training in martial arts will need safety guidance specific to the competition focus of their art.

Some martial arts are largely popular in certain age groups. Mixed martial arts and kick boxing participants are likely to be in the 20-29 year old age group while tai chi usually draws participants from older adults. Judo falls have been taught to the elderly in attempts to decrease falling injuries, and van Swigchem's focus on falls should be further investigated if we are to apply those lessons in the future. Thus, martial arts are not solely for the young, they may be applied to many age groups with factors varying upon style and training regime. Other considerations not studied in this paper or the studies it referenced include the benefits of martial arts practice in teaching discipline, effects of meditation on stress reduction, and maintaining or increasing body strength.

In conclusion, as martial arts develop, they will undergo changes in public opinion, rules and regulations, equipment, and training styles. Though increasing popular attention is given to martial arts, there are still relatively few articles studying this activity and its many nuances such as training methods, injury prevention, and competition styles. While practicing martial arts is likely increase one's risk of injury compared to a sedentary lifestyle, as with other sports, injury rates also depend on frequency of participation and the overall level of athletic fitness of the practitioner. Since rules, regulations, and equipment are still evolving, it is essential to identify their effects on injury rates and determine whether these regulations and equipment can collectively create a safer environment for participants. Additionally, as it is increasingly common for martial arts schools to have multiple or intermixed styles, it is consequently more possible for beginning participants to discover practice styles that are appropriate for their age, body, and goals. Goals of competition, personal growth, discipline, honor, and self defense are only a few of the reasons why a person may join martial arts, but its integral philosophy plays a role in separating it from pure sport.

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Endnotes

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[20] Zetaruck, et al.

[21] For example, Zetaruk, or Ngai.

[22] Kazemi.

[23] For example, Pieter and Zemper, Ngai, or Kazemi.

[24] For example, Macan, or Ngai.

[25] Pieter and Zemper.