

ORIGINAL RESEARCH

DETERMINING THE PREVALENCE AND ASSESSING THE SEVERITY OF INJURIES IN MIXED MARTIAL ARTS ATHLETES

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ABSTRACT

Background. Mixed martial arts (MMA) is currently the fastest growing sport in the United States and has recently surpassed boxing as the most popular full contact sport. Due to the physical nature of the sport, MMA is associated with various types of injuries.

Objective. The purpose of this study was aimed at identifying prevalence and assessing the severity, location, and type of injuries in MMA athletes sustained during MMA related activities in the twelve month period prior to the survey.

Methods. A total of fifty-five subjects between the ages of 18 to 39 participated in the study. Participants were given a two-part questionnaire to collect demographic and injury data.

Results. Two hundred seven injuries were reported in the study. Low belt ranks had significantly more injuries more than any other belt rank, resulting in more than two times higher injury rate. Professional fighters had significantly more injuries than amateur fighters, resulting in three times higher injury rate. The most common body region injured was the head/neck/face (38.2%), followed by the lower extremities (30.4%), upper extremities (22.7%), torso (8.2%), and groin (0.5%). Injuries to the nose (6.3%), shoulder (6.3%), and toe (6.3%) were the most common. The most common type of injury was contusions (29.4%), followed by strains (16.2%), sprains (14.9%), and abrasions (10.1%).

Conclusion. Injury prevention efforts should consider the prevalence and distribution of injuries and focus on reducing or preventing injuries to the head/neck/face in MMA related activities. Preventative measures should focus on improving protective equipment during training, and possible competition rule modifications to further minimize participant injury.

Keywords: sports injuries, mixed martial arts, MMA, combat sports

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INTRODUCTION

Martial arts are ancient forms of combat, modified for modern sport and exercise. Participation in martial arts is increasing and provides health promoting and meaningful exercise for millions of practitioners.¹ Martial arts has been shown to improve participants' cardiovascular endurance, strength, balance, flexibility, body fat composition, stress and relaxation, confidence, and socialization. As with regular physical activity, martial arts can be associated with reducing the risk of premature mortality, hypertension, coronary artery disease, diabetes mellitus, colon cancer, and obesity.²⁻⁴ In addition to these health benefits, however, martial arts activities also carry the obvious risk of injury. Risks can possibly be reduced by using protective equipment, including mouth guards, headgear, groin protectors, and other forms of padding.¹

Mixed Martial Arts (MMA) competition, which is also referred to as no holds barred (NHB) fighting, ultimate fighting, and cage fighting, has its roots in ancient Greece. In 648 BC it was referred to as pankration and was featured at the 33rd Ancient Olympics. Pankration, which is Greek for "all powerful," was the hybridization of boxing and wrestling into a freestyle fighting sport.^{5,6} Pankration was spawned from unarmed combat on the battlefield and became an extremely popular sport.⁷ The sport was revered in ancient Greece and served as the climactic final event of the Olympics for centuries.^{5,6} Since the time of Alexander the Great in 325 BC, pankration attracted attention because of its sheer violence and brutal competition.^{5,7,8}

Mixed martial arts emerged into America pop culture in the early 1990s and has grown immensely in popularity. Mixed martial arts has not always been in the limelight, as it was almost banned completely in the United States due to its brutal nature and limited rules. Mixed martial arts was first introduced in the United States with the first Ultimate Fighting Championships (UFC) in 1993 and immediately faced scrutiny from legislators and the medical community.^{9,10} In the UFC's conception, competitors battled against one another with no time limits, no weight classes, and few rules.¹¹ Referred to as "human cock fighting," the UFC lost their cable television contracts in 1997 and survived underground through the Internet and word of mouth. In 2001, UFC organizers agreed to a modification of rules that allowed the Nevada State Athletic Commission and the New Jersey State Athletic Control Board to sanction MMA competitions.^{9,6} Re-establishing

cable television contracts followed, and the sport's popularity grew greatly in the years to follow. Initially promoted as a violent and brutal sport, MMA has dramatically changed and now has revised rules and improved regulations to minimize the risk of injury.

Mixed martial arts competitions consist of three five-minute rounds (non-championship bouts) or five five-minute rounds (championship bouts), followed by one-minute rest periods between rounds. Competitors are matched according to designated weight classes and similar experience levels (i.e., fight record). Competitors wear protective equipment consisting of a mouth guard, groin protector, and 4 to 6 oz. MMA gloves. Competitors are not allowed to wear shoes, competing barefooted. Mixed martial arts bouts are decided or stopped by a referee if a competitor submits to his or her opponent, suffers a knockout (KO) or technical knockout (TKO), or is disqualified because of rule infractions. A bout can also be stopped if the scheduled match time limit expires.^{5,12}

Mixed martial arts bout stoppages due to KO, TKO, and submission can be classified into three major categories: head trauma, musculoskeletal stress, and neck choke. (Submission occurs when a competitor communicates he or she no longer wishes to continue due to possible impending injury. Submission is communicated by (a) physically tapping the ground, oneself, or opponent multiple times or (b) verbally requesting a bout stoppage.⁵) Head trauma causing bout stoppages includes a competitor exhibiting altered mental status to the point of defenselessness. {Defenselessness is defined as when a competitor loses all unconsciousness and responsiveness (KO) or partial responsiveness (TKO) exposing him or her to further punishment.⁵} Musculoskeletal stress causing bout stoppages includes a competitor being submitted by either a joint lock or other musculoskeletal trauma. A neck choke causing bout stoppages includes a competitor submitting or losing consciousness, due to the application of a neck choke causing asphyxiation, cephalic hypoperfusion, or syncope.⁵

In regards to safety, MMA has been compared to other combat sports, such as boxing. Mixed martial arts has a safer track record in respect to serious injury and death. Knockout rates are lower in MMA competitions than in boxing, suggesting a reduced risk of traumatic brain injury (TBI) in MMA competitions compared to other events involving striking.⁹ Since MMA's conception in the mod-

ern era, only four deaths have been documented. Deaths have occurred in Tijuana, Mexico; Kiev, Ukraine; Samsongdong, South Korea; and the United States. All the MMA documented deaths occurring outside the United States were in unsanctioned fights. The Journal of Combative Sport has documented seventy-one deaths from 1993 to 2007 in boxing with total of 1,355 deaths from 1890 to 2007, averaging 11.6 deaths per year during the modern history of the sport.¹³

Mixed martial arts is currently the fastest growing sport in the United States and has recently surpassed boxing as the most popular full contact sport.^{14,15} As of June 2009, amateur MMA is legal and sanctioned in thirty-five states, and professional MMA is legal and sanctioned in forty states.¹⁶ Due to the physical nature of the sport, MMA is associated with various types of injuries. These injuries range from small contusions and abrasions to more serious conditions including concussions and risk of death.^{9,5,17} Current literature reporting MMA injuries have only focused on injuries in competition alone and no studies have looked at MMA injuries in regular training.^{9,5,7} It is not clear from the literature what risks of injuries exist with regular training.

The purpose of this study was aimed at identifying prevalence and assessing the severity, location, and type of injuries in MMA athletes sustained during MMA related activities in the 12-month period prior to the survey. A secondary objective is to indicate protective equipment self-reported utilization. This study is unique, as it looked at what type of injuries occurred, injury locations on the body, whether the injuries were previous or repeated, amount of time off (rest) from training as a result of the injuries, whether any medical attention was sought, and the setting in which the injuries occurred. Frequently sustained injuries identified within the study will assist in making fighter safety recommendations aimed at preventing future injuries and reoccurrences.

METHODS

A total of fifty-five subjects between the ages of 18 to 39 participated in the study. Participants assessed were men and women of both amateur and professional status. Participants were given a two-part questionnaire (*See Appendix*) to retrospectively collect demographic and injury data. The questionnaire was developed by the author and assessed via face validity by a board certified sports physical therapist with 21 years of experience. Part

one of the questionnaire included assessing each participant's age, sex, primary martial art style, years of training experience, hours of training per week, protective equipment used, and current fighter status (amateur vs. professional). Part two of the questionnaire included assessing thirty injured body regions, types of injuries, repeated injuries, required time off from training, medical attention sought, and setting in which the injuries occurred. Participants were also given an injury diagnosis sheet (*See Appendix*), which gave a definition of all the injury types listed on part two of the questionnaire. Injury definitions were provided in laymen terms for better participant understanding of injury types. The questionnaire did not allow the recording of multiple injuries to the same anatomical location. To accommodate for this, participants were given multiple copies of the survey tool to record multiple injuries.

Mixed martial arts facilities were selected due to their close proximity from the researchers resulting in a sample of convenience. Twenty-four MMA training facilities across the Midwest including Missouri, Kansas, and Illinois were identified and contacted for their participation in the study. Eight of the twenty-four MMA training facilities agreed to participate in the study. Each MMA training facility was contacted by the author via phone or e-mail. Each facility was then scheduled a site visit by the researchers to survey their fighters either before or after one of their training sessions. Both amateur and professional MMA fighters were asked to participate. Care was taken to make sure that all participants surveyed were fighters who were currently training for a future MMA bout.

The training session appointments were organized where participants were verbally explained the study's procedures, benefits and risks of participation, and confidentiality. All the subjects were given an informed consent that was required to be signed before the subject was allowed to participate in the study. Approval was obtained by the Research Review Board (RRB) at Southwest Baptist University, Springfield, Missouri to conduct the study. The subjects then received their individual questionnaire packets, which took approximately five to ten minutes to complete. Questionnaires were placed in an envelope and sealed. At a later date, the collected data from the participants was compiled and analyzed thoroughly.

Confidentiality of the data was maintained throughout the study in two ways. First, no names or personal identification was required to complete the questionnaire. Second, each participant was given a separate individual questionnaire which was sealed in an envelope when completed.

Data Analysis

The injury data was transferred into SPSS (Statistical Package for Social Sciences) version 12 for analysis. Injury rates were analyzed per total number of participant injuries by age, sex, martial art style, belt rank, years of training experience, hours of training per week, and fighter status. The t-tests were used for sex and fighter status, and analysis of variance (ANOVA) was used for remaining groupings. Scheffe post hoc was used to analyze the significant differences of the ANOVA results. The initial alpha level was set at $p < 0.05$. Given that four ANOVAs and one t-test were used (a total of five comparisons), a Bonferroni correction of $0.05/5 = 0.01$ was used for analysis.

RESULTS

Of the fifty-five subjects participating in the study, 33.3% were ages 18 to 21, 27.8% ages 22 to 25, 22.2% ages 26 to 29, 11.1% ages 30 to 33, and 5.6% ages 34 to 39. The injury rate among participants ages 30 to 33 averaged 6.2 injuries (SD = 4.2) per subject. Participants ages 22 to 25 averaged 5.2 injuries (SD = 6.1) per subject, followed by 3.3 injuries (SD = 2.5) per subject for ages 26 to 29, 3.3 injuries (SD = 2.3) per subject for ages 34+, and 2.4 injuries (SD = 3.2) per subject for ages 18 to 21. ($F = 1.335$, $df = 54$, $p > .05$)

Sex differences were also accessed during the study. Of the participating subjects, 94.5% were male and 5.5% were female. Males and females averaged different injury rates. Male participants averaged 3.9 injuries (SD = 4.3) per subject and female participants averaged 2.3 injuries (SD = 2.5) per subject. ($t = 0.595$, $df = 0.53$, $p > .05$)

Two hundred seven injuries were reported in the study. Twenty-seven of the injuries reported were

multi-injurious in nature, resulting in a total of two hundred twenty-eight separate injury outcomes. Multi-injurious is defined as an injury resulting in multiple outcomes, such as leg kick causing a simultaneous contusion and sprain. The most common body region injured was the head/neck/face (38.2%), followed by the lower extremities (30.4%), upper extremities (22.7%), torso (8.2%), and groin (0.5%). (See Table 1) This result seems plausible since a major target area of MMA competition is the head/neck/face. When looking at specific body region injury, the nose (6.3%), shoulder (6.3%), and toe (6.3%) were the most commonly injured followed by eye (5.8%), neck (5.8%), knee (5.8%), head (5.3%), ear (5.3%), and ankle (4.8%). (See Table 2 for all thirty injured body regions and their percentage of injuries.)

The most common type of injury reported by the participants was contusions (29.4%), followed by strains (16.2%), sprains (14.9%), abrasions (10.1%), joint trauma (9.2%), fractures (5.7%), lacerations (5.3%), other miscellaneous trauma (4.8%), dislocations (2.6%), concussions (1.8%), and internal organ trauma (0.0%). (See Table 3) Of these injuries, 32.4% were repeated or previous injuries, 20.1% required medical attention, and 77.9% occurred in training compared to 22.1% that occurred in competition. The most common amount of time off (rest) required after the injuries was 0 days (56.8%), followed by 4 to 6 days (11.5%), 1 to 3 days (10.9%), 7 to 9 days (10.4%), and 10+ days (10.4%).

The most common martial art style was wrestling (36.2%), followed by jiu-jitsu (34.0%), freestyle (21.3%), kickboxing (8.5%), and boxing (0.0%). For analysis purposes, injury rates were reported for those participants who declared only one primary martial art style. Those

participants who selected multiple primary martial art styles were excluded. The injury rate among participants with a jiu-jitsu martial art style averaged 6.0 injuries (SD = 4.8) per subject, followed by 3.8 injuries (SD = 3.7) per subject for freestyle, 2.5 injuries (SD = 4.6) per subject for wrestling, and 2.0 injuries (SD = 2.8) per sub-

Table 1 General Region of Injury (n = 55)

Body region injured	Number of injuries	Percentage of injuries
Head/face/neck	79	38.2
Lower extremities	63	30.4
Upper extremities	47	22.7
Torso	17	8.2
Groin	1	0.5
Total	207	100

ject for kickboxing. ($F = 1.865$, $df = 54$, $p > .05$)

Experience level of the subjects was evaluated by accessing (a) martial art belt rank and (b) years of martial arts training. Since belt ranks are different among various martial arts, low and high belt ranks were used to distinguish experience levels. Low belt ranks are participants who possess a novice skill level. Whereas, high belt ranks are participants who possess a more seasoned skill level. The only constant belt ranks among martial arts that use a belt rank system are white belt (beginner) and black belt (expert). There are martial arts, such as boxing, kickboxing, and wrestling, that do not use a belt rank system and these participants are designated in this study as having no belt rank. Of the participating subjects, 62.9% held no belt rank, 16.7% held white belt rank, 9.3% held low belt ranks, 9.3% held high belt ranks, and 1.8% held black belt rank. The highest injury rate among belt ranks was low

belt ranks, averaging 12.2 injuries ($SD = 6.1$) per subject. Low belt ranks had significantly more injuries than any other belt rank, resulting in more than two times higher injury rate. White belt rank averaged 5.2 injuries ($SD = 3.1$) per subject, followed by 5.0 injuries ($SD = 2.8$) per subject for high belt ranks, 5.0 injuries were reported by the one black belt rank, and 2.0 injuries ($SD = 2.6$) per subject for no belt rank. For analysis purposes, the black belt group was removed. ($F = 16.519$, $df = 52$, $p = 0.000$)

Table 2 Specific Region of Injury (n = 55)

Injury Type	Number of injuries	Percentage of injuries
Nose	13	6.3
Shoulder	13	6.3
Toe	13	6.3
Eye	12	5.8
Neck	12	5.8
Knee	12	5.8
Head	11	5.3
Ear	11	5.3
Ankle	10	4.8
Finger	9	4.3
Lower Leg	9	4.3
Foot	9	4.3
Lip	8	3.9
Cheek	7	3.4
Elbow	7	3.4
Upper Back	6	2.9
Lower Back	6	2.9
Upper Arm	6	2.9
Hand	6	2.9
Jaw	5	2.4
Chest	4	1.9
Wrist	4	1.9
Hamstring	4	1.9
Thigh	3	1.4
Forearm	2	1.0
Abdomen	1	0.5
Pelvis	1	0.5
Hip	1	0.5
Coccyx	1	0.5
Groin	1	0.5
Total	207	100

In regards to martial arts training experience, 47.3% had less than 1 year training experience, 14.5% had 1 to 2 years training experience, 10.9% had 2 to 3 years of training experience, 9.1% had 3 to 4 years of training experience, and 18.2% had 4+ years of training experience. The injury rate among participants with 3 to 4 years of martial arts training experience averaged 7.8 injuries ($SD = 3.0$) per subject. Participants with 2 to 3 years training experience averaged 4.8 injuries ($SD = 6.5$) per subject, followed by 4.8 injuries ($SD = 5.4$) per subject with 4+ years training experience, 3.5 injuries ($SD = 4.0$) per subject with 1 to 2 years training experience, and 2.4 injuries ($SD = 2.9$) per subject with 1 year or less of training experience. ($F = 2.195$, $df = 54$, $p > .05$)

Hours of training per week were accessed showing 36.4% train 12 or more hours per week, 23.6% train 6 to 8 hours per week, 21.8% train 3 to 5 hours per week, 14.6% train 9 to 11 hours per

week, and 3.6% train 2 hours or less per week. The injury rate among participants with 6 to 8 hours of training per week averaged 5.1 injuries ($SD = 5.2$) per subject. Participants who trained 12+ hours per week averaged 4.0 injuries ($SD = 4.6$) per subject, followed by 3.4 injuries ($SD = 4.3$) per subject who trained 9 to 11 hours per week, 2.8 injuries ($SD = 2.4$) per subject who trained 3 to 5 hours per week, and zero injuries per subject who trained 2 hours or less per week. Injury rate calculated among participants occurred in both training and competition settings. ($F = 0.866$, $df = 54$, $p > .05$)

Fighter status was assessed showing 92.7% were amateur fighters compared to 7.3% that were professional fighters. Professional fighters had significantly more injuries than amateur fighters, resulting in three times higher injury rate. Professional fighters averaged 11.0 injuries (SD = 6.3) per subject and amateur fighters averaged 3.2 injuries (SD = 3.6) per subject. ($t = -3.985$, $df = 53$, $p = 0.000$)

The most common protective equipment used was a mouth guard (100%), followed by a groin protector (87.1%), MMA gloves (83.9%), hand wraps (64.5%), shin guards (58.1%), boxing gloves (45.2%), head gear (38.7%), knee pads (19.4%), wrestling shoes (19.4%), and other equipment (16.1%). (See Table 4)

DISCUSSION

In this study, a significant difference was observed showing low belt ranks reporting a significantly higher injury rate than all other belt groupings. The author believes this could be contributed to low belt ranks having less training experience and being exposed to the identical amount of live sparring as more experienced fighters (higher belt ranks), thus increasing their risk to injury. By tradition, low belt ranks have less training experience resulting in less overall skill, proper technique execution, and defensive strategies. During live sparring against more experienced fighters, the author believes low belt ranks suffer a higher injury rate secondary to less overall experience compared to

Table 3 Injury Type (n = 55)

Injury Type	Number of injuries	Percentage of injuries
Contusion	67	29.4
Strain	37	16.2
Sprain	34	14.9
Abrasion	23	10.1
Joint Trauma	21	9.2
Fracture	13	5.7
Laceration	12	5.3
Other	11	4.8
Dislocation	6	2.6
Concussion	4	1.8
Internal Organ	0	0
Total	228	100

their more experienced training partners. The author believes white belts have an overall lower exposure to injuries, due to limited exposure to live sparring. Due to their limited experience level and “beginner” status, white belts do not participate in live sparring to the same degree (intensity, duration, or frequency) as low and high belt ranks.

A significant difference was observed showing professional fighters reporting a three times higher injury rate than amateur fighters. The author believes this difference could be contributed to rule modification for

professional bouts compared to amateur bouts. Within professional bouts, fighters are allowed to utilize elbow strikes to their opponents' head and body. This rule modification may increase the likelihood of injuries to both participants in a professional bout. Other possible reasons of increased incidence of injuries to professional fighters may be due to longer rounds in professional fights compared to amateur fights (5 minutes versus 3 minutes). This increased incidence of injury exposure may allow for more injuries to occur within a professional MMA bout.

Table 4 Protective Equipment Utilized (n = 31)

Protective Equipment	Number of usage	Percentage of usage
Mouth Guard	31	100
Groin Protector	27	87.1
MMA Gloves	26	83.9
Hand Wraps	20	64.5
Shin Guards	18	58.1
Boxing Gloves	14	45.2
Head Gear	12	38.7
Knee Pads	6	19.4
Wrestling Shoes	6	19.4
Other	5	16.1

The relative high incidence of injuries in combat sports has been well documented in the literature.⁹ Martial art styles that involved striking—such as boxing, kickboxing, karate, and tae kwon do have been shown to have a higher incidence of injury than styles that involve grappling alone, such as collegiate wrestling. Injuries in the striking martial arts are prevalent not only in the target areas of the face and torso, but

also the hands in boxing and the upper and lower extremities in kickboxing and karate.⁹

Zazryn et al¹⁸ reported overall injury rates of professional boxers and kickboxers in Victoria, Australia, over a 16 year period. An injury rate of 25 injuries per 100 fight participations were reported in professional boxers. An injury rate of 109.7 injuries per 1,000 fight participants were reported in professional kickboxers with the head/neck/face (52.5%) being the most common body region injured, followed by the lower extremities (39.8%), upper extremities (3.2%), and trunk (2.3%). Injuries to the lower leg (23.3%), face (19.4%), and intracranial region (17.2%) were the most common. The most common injury type was superficial contusion (39.5%), followed by laceration (24.9%) and concussion (17.5%).^{9,19}

Bledsoe et al^{20,9} reported an overall injury rate of professional boxers of 17.1 per 100 fight participations or 3.4 per 100 boxing rounds. Facial laceration was the most common injury reported and accounted for 51% of all injuries, followed by injuries to the hand (17%), eye (14%), and nose (5%).^{20,9} The high incidence of head/face injuries in boxing suggest that efforts should be made to devise better materials that reduce the transfer of impact forces from the upper extremity to the head/face during a strike.²¹

Bledsoe et al⁹ reported an overall injury rate of professional MMA athletes of 28.6 injuries per 100 fight participations or 12.5 injuries per 100 competitor rounds.⁹ Facial laceration was the most common injury accounting for 47.9% of all injuries, followed by injuries of the hand (13.5%), nose (10.4%), and eye (8.3%). Mixed Martial Arts competitions demonstrate a high rate of overall injury; however, keeping with other striking combat sports, such as boxing, kickboxing, karate, and tae kwon do.⁹

Grappling sports have demonstrated much lower injury rates compared to striking martial arts. Collegiate wrestling has been documented to have injury rates as low as 1 injury per 100 participations during practice and competition with the upper extremities (44.3%) being the most common body region injured, followed by lower extremities (20.5%), trunk (17.9%), and head/face (16.9%).^{9,22,21} Strains and sprains were the most common injury reported and accounted for 36.4% of all injuries, followed by fractures (21.3%) and contusions and abrasions (16.0%).²¹ Unlike boxing, wrestling involves grappling and maneuvering the opponent which frequently results in extreme

positions for the joints. The forces and positions encountered in wrestling may frequently result in elongation of the muscles and ligaments beyond their physiologic range.²¹

The highest percentage of MMA injuries was contusions occurring to head/neck/face, followed by strains and sprains to lower and upper extremities. The study's results of injury prevalence, type, and location were consistent among other combat sports according to the existing literature. Mixed Martial Arts involves both striking and grappling components resulting in similar injury type and location. Striking styles (such as boxing and kickboxing) show contusions and lacerations to the head/neck/face as the most prevalent injury, and grappling styles (such as wrestling) show strains and sprains as the most prevalent injury.

This study shows that over three times the amount of injuries occurred in training rather than actual competition. Of the fighters surveyed, 61.3% do not use head gear during training. The highest percentage of MMA injuries occurred to the head/neck/face, resulting in 38.2% of the total injuries. Of all the fighters surveyed, 87.1% wore groin protectors, which was the second most utilized piece of equipment next to mouth guards. This resulted in 0.5% total groin injuries.

Studies indicate that the risk of an orofacial sports injury was 1.6 to 1.9 times higher when a mouth guard was not worn.²³ Of all the fighters surveyed, 100% wore mouth guards indicating the highest use of protective equipment among participants. This resulted in only 2.4% total jaw injuries indicating the lowest incidence of injury for any head/neck/face anatomical area. Impact studies have shown that compared with no mouth guard, mouth guards composed of many types of materials reduce the number of fractured teeth and head acceleration.²³

Limitations of this study include a limited sample size and the participants' specific geographical area. Participants surveyed in this study lived and trained in the Midwest. Mixed Martial Arts competitors who train outside the Midwest may train differently, thus predisposing them to different injury rates, various injury types, and assorted injury prevention practices. The majority of participants in this study declared a form of grappling (wrestling and jiu-jitsu) as their primary martial art style, which may have exposed them to specific injuries and locations than those

who declared a form of striking as their primary martial art style (boxing and kickboxing). Increasing the sample size, geographic area surveyed, and primary martial art style distribution accessed would further increase the study's validity.

Even though participants were given an injury diagnosis sheet, which gave a definition of all the injury types listed on the participant questionnaire, self assessment of injury diagnoses may have been inaccurate. Injuries sustained during training could have been falsely assumed to be the same type of injuries that occurred in competition. Other limitations of this study include determining the number of participants that refused to participate in the study and the lack of the participant questionnaire (survey tool) being validated by an outside source. Additional studies should focus on improving upon these limitations, which would help strengthen and validate some of its findings and conclusions.

CONCLUSION

Despite the attempts to ban it by legislators and the medical community, MMA grew in the 1990s from an underground spectacle into an internationally sanctioned sport. This transformation was driven by modifying the rules to make the competition safer to the athletic governing commissions. This ultimately led to increased event exposure, more lucrative incentives offered to the competitors, and ultimately leading to the sport's growing popularity.^{5,12,24} With the ever-growing popularity of MMA, more participants are getting involved in the sport and increasing their risk of injury.

The growing popularity of MMA has forced the medical community to take notice and focus on preventative measures to reduce the MMA participant's risk of injury. Preventative measures should focus on improving protective equipment during training, and possible competition rule modifications to further minimize participant injury. However, recommendation of rule modifications is premature and future studies are warranted to validate this claim. This study will hopefully be the first of many instruments for making future recommendations to keep MMA fighters safe and competing at their best.

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APPENDIX

QUESTIONNAIRE: PART I – DEMOGRAPHIC DATA

Please read and answer the following eight (8) questions by circling the letter that most represent you. Thank you for your participation in this survey!

1. What is your age?

a. 18-21 yrs, **b.** 22-25 yrs, **c.** 26-29 yrs, **d.** 30-33 yrs, **e.** 34+ yrs

2. What is your gender?

a. Male, **b.** Female

3. Which is your primary martial art/style?

a. Jiu-jitsu, **b.** Boxing, **c.** Kickboxing, **d.** Wrestling, **e.** Freestyle, **f.** Other

4. What is your belt rank?

a. White belt, **b.** Lower Belts, **c.** Higher Belts, **d.** Black Belt, **e.** No Rank

5. How many years of training have you had?

a. 0-1 yrs, **b.** 1-2 yrs, **c.** 2-3 yrs, **d.** 3-4 yrs, **e.** 4+ yrs

6. How many hours of training per week do you practice?

a. 0-2 hrs/wk, **b.** 3-5 hrs/wk, **c.** 6-8 hrs/wk, **d.** 9-11 hrs/wk, **e.** 12+ hrs/wk

7. What protective equipment do you wear? (circle all that apply)

a. Mouth Guard, **b.** Groin Protector, **c.** Hand Wraps, **d.** Shin Guards, **e.** Head Gear, **f.** Knee Pads, **g.** Wrestling Shoes, **h.** Boxing Gloves, **i.** MMA Gloves, **j.** Other

8. What is your current fighter status?

a. Amateur, **b.** Professional