

Combat Sports Injury Epidemiology (So, you want to be a ringside doc?)

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Acknowledgement

- I have no conflicts of interest to declare
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Top 20 Combat sports (World)

1. Boxing	11. Fencing	 Malaysia 1. Silat
2. Mixed Martial Arts (MMA)	12. Kendo (Japan)	
3. Wrestling	13. Wushu/KungFu (Chinese)	
4. Judo	14. Sumo	
5. Taekwondo	15. Sanda/Sanshou (Chinese)	
6. Brazilian Jiu-Jitsu (BJJ)	16. Jui/Jitsu (Japan)	
7. Karate	17. Capoeira (Afro-Brazilian)	
8. Muay Thai	18. Savate (French Boxing)	
9. Kickboxing	19. Lethwei (Burma bare boxing)	
10. Sambo	20. Aikido (Japan)	

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Global participation rates

1. Boxing	World Boxing Council	20 million [1]	Richest
2. Taekwondo	World Taekwondo Federation	70 million [2]	Olympics
3. Judo	International Judo Federation	20 million [3]	Olympics
4. Karate	World Karate Federation	50-100 million [4]	Largest
5. Wrestling	United World Wrestling	20 million [5]	
6. Braz Jiu-Jitsu	Int. Brazilian Jiu-Jitsu Federation	2-3 million [6]	
7. Muay Thai	Int. Fed. Muay Thai Associations	3-5 million [7]	
8. MMA	UFC and allied organizations	5+ million [8]	Fastest growing
9. Kickboxing	World Assoc. Kickboxing Org	2-3 million [9]	
10. Kung Fu	Int. Wushu Federation	4-5 million [10]	

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Individual Combat Sport Epidemiology

- Fight participations
 - Actual combat sport competitions.
- Athlete exposures (AE)
 - Any involvement with sport where an athlete could potentially sustain an injury
- Injury Rates
 - Per 100
 - Per 1000



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Tae Kwon Do

Injuries

- Lower extremities (45-65%)
- Head/face (15-25%)
- Upper extremities (10-15%)
- Trunk (8-12%)

Mechanism of Injury

- Comp ruleset (Olympic vs. Traditional)
- Weight category
- Experience level
- Protective equipment quality
- Kicking technique proficiency

Pro

- Comp: 9.2 / 1000 athlete-exposures (AE) [1]
- Training: 5.5 / 1000 AE

Amateur

- Comp: 5.7 / 1000 AE [2]
- Training: 3.2 / 1000 AE



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2824446/

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Brazilian Jiu-Jitsu (BJJ)

Comp [9]

- Elbow : 41.2%
- Knee : 31.4%
- Shoulder : 22.1%
- Ankle/foot : 5.3%

Mechanism [9]

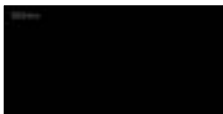
- Joint locks: 42.8%
- Throws: 24.3%
- Guard positions: 19.6%
- Other: 13.3%

Pro

- Comp: 9.2 / 1000 (AE) [1]
- Training: 5.5 / 1000 AE

Amateur

- Comp: 5.7 / 1000 AE [2]
- Training: 3.2 / 1000 AE



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Muay Thai

Comp [7]

- Lower extremity bruising: 53%
- Head injuries: 28%
- Upper extremity injuries: 19%

Training [8]

- Shin contusions: 55%
- Ankle sprains: 27%
- Knee injuries: 18%

Pro

- Comp: 13 - 25 / 1000 (AE) [1,2]
- Training: 7.8 / 1000

Amateur

- Comp: 8.3 / 1000 [3]
- Training: 4.5 / 1000



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Silat

Pro

- Comp: **65:115 / 1000** (AE) [1]
- Training: **22.4 / 1000**

- **Features:**
 - Strikes, kicks, throws
 - Joint locks
 - Weapons training
 - Inspired by:
 - natural movements
 - animal fighting styles
- **Comp categories:**
 - Tanding (sparring matches)
 - Seni (artistic forms)
 - Weapons demonstrations
 - Kris (dagger)
 - Tongkat (spear)



Amateur

- Comp: **48.7 / 1000** [2]
- Training: **16.8 / 1000**

- **Injury locations**
 - Lower limb: 41.4%
 - Upper limb: 32.6%
 - Head / neck: 15.2%
 - Trunk: 10.8%[2]
- **Type**
 - Contusions (38.3%)
 - Strains/sprains (27.1%)
 - Lacerations (12.4%) [3]

2. McKeown Brown AH, et al. Asian J Sports Med. 2012;3(2):102-108

3. Nijharatana, et al. J Sports Med. 2012;3(2):102-108

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Boxing

Head Injuries [1,2,3]

- Concussion rate:
 - 0.8 per 100 boxer-rounds
- Chronic traumatic encephalopathy (CTE)
 - 17% of pro boxers
- Acute subdural hematoma:
 - most common cause death (75%)

Other [4]

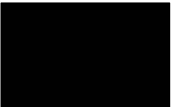
- Hand/wrist : 28%
- Facial lacerations: 29%
- Shoulder : 7%

Pro

- Comp: **118-250 / 1000 (AE) [2]**
- Training: **51.6 / 1000 AE**

Amateur

- Comp: **77.7 / 1000 AE [3]**
- Training: **17.9 / 1000 AE**



<https://www.youtube.com/watch?v=uk2hCZrGgqg>

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Mixed Martial Arts (MMA)

- **Location [5]**
 - Head/neck: 38.2%
 - Lower extremity: 30.4%
 - Upper extremity: 22.7%
 - Torso: 8.7%
- **Injury type [6]**
 - Lacerations: 47.9%
 - Fractures: 13.5%
 - Concussions: 8.3%
 - Ligament tears: 7.4%

Pro

- Comp: 228-286 / 1000 (AE) [2]
- Training: 40.3 / 1000

Amateur

- Comp: 120.4 / 1000 [3]
- Training: 33.7 / 1000



<http://www.pubmed.ncbi.nlm.nih.gov/20240164/>

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FIGURE 1. Injury patterns in MMA. The most common injury pattern was head/neck (38.2%), followed by lower extremity (30.4%), upper extremity (22.7%), and torso (8.7%). The most common injury type was lacerations (47.9%), followed by fractures (13.5%), concussions (8.3%), and ligament tears (7.4%).

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Traditional martial arts

Primary Characteristics

- Form-based training
- Cultural techniques
- Variable contact levels

Common Injury Profile

- Lower: 45-55%
- Upper: 25-35%
- Head/face: 15-20%

1. Karate

- Injuries: Contusions, sprains
- Injury rate: **7.4 / 100 participations**
- Key risk: Lower extremity injuries

2. Taekwondo

- Injuries: Lower limb trauma
- Injury rate: **8.3 / 100 participations**
- Key risk: Kicking-related injuries



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Grappling dominant Sports (Ground based)

Primary Characteristics

- Focus: submissions, holds, pins
- Ground-based techniques
- Joint manipulation

Common Injury Profile

- Joint injuries: 45-55%
- Muscle strains: 25-35%
- Acute trauma from throws: 15-20%

1. Brazilian Jiu-Jitsu

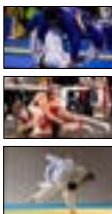
- Injuries: Joint sprains, muscle strains
- Injury rate: **9.2 / 100 fight participations**
- Key risk: Joint lock injuries

2. Wrestling

- Injuries: Knee injuries, shoulder dislocations
- Injury rate: **12.8 / 100 fight participations**
- Key risk: Acute joint trauma

3. Judo

- Injuries: Shoulder/knee sprains, contusions
- Injury rate: **11.6 / 100 fight participations**
- Key risk: Throwing-related trauma



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Strike dominant Sports (Standing)

Primary Characteristics

- Focus: punches, kicks, elbows, knees
- Predominantly upright fighting
- Impact-based techniques

Common Injury Profile

- Head/face : 40-60% of all injuries
- Upper extremity trauma: 20-30%
- Lower body impact injuries: 15-25%

1. Boxing

- Injuries: Concussion, facial cuts, hand fractures
- Injury rate: **17.1 / 100 fight participations**
- Key risk: Chronic traumatic encephalopathy (CTE)

2. Muay Thai

- Injuries: Lower limb contusions, ankle sprains
- Injury rate: **18.2 / 100 fight participations**
- Key risk: Shin/kick trauma

3. Kickboxing

- Injuries: Lower extremity, head trauma
- Injury rate: **16.5 / 100 fight participations**
- Key risk: Leg injuries





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Hybrid Systems (Mixed Techniques)

Primary Characteristics

- Combination: striking + grappling
- Variable fighting positions
- Multiple technical approaches

Common Injury Profile

- Head/face injuries: 35-45%
- Joint/muscle injuries: 30-40%
- Combined trauma: 20-25%

1. Mixed Martial Arts (MMA)

- Injuries: Head trauma, joint injuries
- Injury rate: **28.6 / 100 fights**
- Key risk: Combined striking / grappling trauma

2. Combat Sambo

- Injuries: Joint injuries, contusions
- Injury rate: **14.9 / 100 fights**
- Key risk: Submission-related




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**Training vs Comp
&
Skill Level Comparison**

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Boxing [2]

Comp:

- Acute head injuries: 58%
- Facial cuts: 51%
- Hand injuries: 17%

Training:

- Shoulder injuries: 24%
- Hand/wrist injuries: 33%
- Lower back strain: 19%

Pro:

- Concussion rate:
 - 17.1 / 100 participations
- Facial lacerations: 51%
- Hand fractures: 17%

Amateur:

- Concussion rate:
 - 4.1 / 100 participations
- Facial lacerations: 25%
- Hand injuries: 15%

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MMA [4]

Comp:

- Head/neck : 78.7%
- Laceration : 47.9%
- Orthopedic : 13.5%

Training:

- Knee : 23%
- Shoulder : 19%
- Back : 18%

Pro:

- Overall injury rate:
 - 28.6 / 100 participations
- Knockout rate: 6.4%
- Technical knockout rate: 17.5%

Amateur:

- Overall injury rate:
 - 15.8 / 100 participations
- Knockout rate: 1.2%
- Technical knockout rate: 7.25%

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Muay Thai [5,6]

Comp:

- Lower limb : 53.4%
- Head : 28.1%
- Upper limb : 18.5%

Training:

- Shin contusions: 55.4%
- Muscle strains: 24.3%
- Joint sprains: 20.3%

Pro:

- Injury rate:
 - 18.2 / 100 participations
- Contusion : 47.4%
- Joint injury : 25.3%

Amateur:

- Injury rate:
 - 12.8 / 100 participations
- Contusion : 41.2%
- Joint injury : 20.1%

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Brazilian Jiu-Jitsu [7,8]

Comp:

- Joint injuries: 41.2%
- Sprains: 31.4%
- Strains: 27.4%

Training:

- Minor sprains: 39.2%
- Muscle strains: 32.1%
- Skin infections: 28.7%

Pro:

- Joint lock injuries: 45.9%
- Spinal injuries: 9.7%
- Muscle strains: 44.4%

Amateur:

- Joint lock injuries: 30.2%
- Spinal injuries: 4.8%
- Muscle strains: 65%

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Bottom line: Competition vs Training

- Comp injuries:
 - more acute and severe
- Pro athletes:
 - higher injury rates but better injury management
- Training injuries:
 - often overuse-related
- Amateur:
 - lower rates of severe injuries
- Head injuries:
 - more common in comp
- Pro athletes:
 - higher technical injury rates (joint locks, submissions)
- Training injuries:
 - more preventable



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Risk Factors Contributing to Differences

1. Competition intensity
2. Experience level
3. Weight cutting impact
4. Technical proficiency
5. Protective equipment use
6. Rule variations
7. Medical supervision levels



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Weight class differences

MMA [1,2] General Injuries • Heavyweights 9.1 / 100 AE • Lightweights 7.2 Head • Heavies 78.3% • Lights 64.1%	Boxing [3,4] • Heavies 17.1 / 100 AE • Lights 11.3 Concussion • Heavies 23.6% • Lights 15.2%	Wrestling [5,6] Middleweights highest • 8.2 / 100 AE Lower extremities 41.6% • Heavies 78.3% • Lights 64.1% • Few head strikes in wrestling • Explains the differences!
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Competition v Training injuries [1,2,3]

Comp
• 2.9 x more likely severe

Acute trauma
• 78.7% comp
• 42.4% training

Concussion:
• Comp 14.7 / 1000 exposures
• Training 3.8 / 1000 exposures



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Pro vs Amateur Recovery Patterns [4,5]

Medical Support

- Pro fighters
 - Pro 2.7 medical consults / injury
 - Amateur 1.3
- Return to training time
 - 23% faster in pro

Injury Management

- Pro fighter
 - 89% compliance with medical advice vs
 - 67% in amateurs
- Access to immediate medical care
 - 94% pro events vs
 - 62% amateur events



<https://www.nytimes.com/2022/07/02/sports/boxing/boxing-injuries.html>

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Training Injury Characteristics [6,7]

Common Training Patterns

- Overuse
 - 65.3%
- MSK
 - 73.1%

Risk Factors

- > training vol > injury rate
- Poor recovery time
 - 42% training injuries



<https://www.bellatrix.com/blog/training-for-competition-or-training-for-fun>

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Amateur Safety Regulations Impact [8,9]

Protective Equipment

Head guard

- ↓ concussion 58% in amateur boxing

Larger glove size

- ↓ hand injuries by 41%

Rule Modifications

- Restricted technique rules ↓ severe injury by 63.7%
- Modified scoring systems ↓ knockout by 78%



<https://theboxinglink.com/boxing-safety-and-medical-rules/>

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Head Injury Competition Prevalence [10,11]

MMA head injury rate:

- Comp: 16.5 / 100 athlete exp
- Training: 4.2 / 100 athlete exp

Boxing concussion rate:

- Comp: 17.1%
- Training 3.8%



<https://med.illhgh.com/1.jpg>



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Technical Injury Patterns in Pros [12,13]

Submission-Based Sports

BJJ joint lock success:

- Pro 47% vs Amateur 23%
- 1.7x ↑ tech submission injury rate in pro

Strike-Based Sports

Knockouts

- Pro 7.3%
- Amateur 2.1%

Technical knockout rate:

- Pro 15.4%
- Amateur 5.7%



<http://www.ortho.maym.com/du204>

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Key Prevention Recommendations

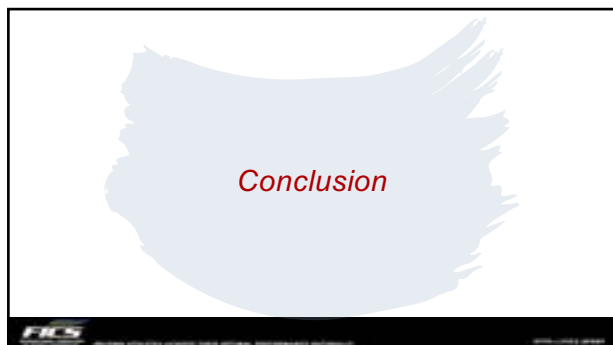
1. Mandatory rest periods between competitions
2. Weight-cutting regulations
3. Protective equipment requirements
4. Standardized medical screening
5. Concussion protocols
6. Technical skill requirements
7. Age-specific comp rules



<http://www.ortho.maym.com/du204>

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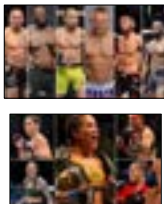
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Combat Sports Injury: Summary

- **Scope of Combat Injuries**
 - Head/face: 40-60% striking sports, 15-20% trad martial arts
 - Joint injuries: 45-55% grappling sports
 - Lower extremities: 53% Muay Thai, 45-65% Taekwondo
- **Injury Rate**
 - MMA: Highest overall injury rate (28.6/100 fights)
 - Boxing: Highest concussion rate (17.1%)
 - BJJ: Highest joint injury rate (41.2%)
- **Key Comparative Findings**
 - Comp 2.9x > training
 - Pro : higher injury rates but 23% faster recovery
 - Heavyweights: significantly higher head injury risk
- **Safety Measures**
 - Headgear: 58% ↓ amateur boxing concussions
 - Modified rules/scoring: 78% ↓ in knockouts



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Thankyou !!



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