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## Original Article

# Injury epidemiology of Ultimate Frisbee in Hong Kong

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## ABSTRACT

**Background:** Ultimate Frisbee is a non-contact, self-refereed team sport that is rapidly gaining popularity in Hong Kong. As it is a physically demanding competition, it can result in substantial injury risk. However, the injury epidemiology data in Hong Kong remains lacking. The aim of this study is to identify and analyse the injury prevalence and risk factors for Ultimate Frisbee players in Hong Kong.

**Methods:** Online self-reported surveys were collected from participants through the Hong Kong Flying Disc Federation for the 2019 season. Data was collected on injury type, location, nature, severity and onset. Injury incidence rates (IRs) were calculated as injuries per 1000 h of athlete-exposures (AEs). Incidence rate ratios were determined to compare IRs with 95% confidence intervals, which were used to calculate differences. In addition, analysis on IR will be made on comparing between training and tournament.

**Results:** Response rate of 75.6% was achieved, of which 59 entries were included for analysis. We observed 54 injuries over 9412 AEs for a total IR of 5.74 per 1000 h of AEs. The injury prevalence is 62.7%, with both men and women having similar incidence (IRR = 1.161, 95% CI = 0.63, 2.14,  $p = 0.63$ ). The most common injuries were in the lower limb (61.1%). Cutting was the most frequent injury mechanism (23.7%). The risk of injury during training is 3 times less compared to during tournament (IRR = 0.03, 95% CI = 0.18, 0.60,  $p < 0.01$ ).

**Conclusion:** Our preliminary findings provide evidence that majority of Ultimate injuries in Hong Kong players involved the lower extremity with injuries occurring more in tournaments than training. This study is an important first step to provide the groundwork for tailoring prevention strategies to minimize injuries in Ultimate Frisbee.

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## 1. Introduction

Ultimate Frisbee, also known as Ultimate, is a fast-paced, non-contact, self-refereed team sport played with a flying disc. Two teams of seven athletes compete on a 100 by 37-m field with the aim to score on the opposition's end zone (or goal area). In order to score a goal, the players of each team will try to gain possession of the frisbee, pass it from one teammate to the other, and catch it within the opposition's endzone.<sup>1</sup>

Ultimate Frisbee has gained much popularity in the western

countries. In 2012, there were estimated 5.1 million Ultimate players in the United States alone.<sup>1</sup> In addition, there are professional and semi-professional Ultimate leagues competing annually across North America and Europe. Ultimate Frisbee is still a relatively new sport to Asia. In Hong Kong, Ultimate Frisbee is rapidly gaining popularity with the establishment of Hong Kong Flying Disc Federation (HKFDF) and promotion of the sport of Ultimate Frisbee. The association's membership almost doubled between 2014 and 2016. There were around 119 active Ultimate players registered for the 2019 season. Additionally, the Hong Kong national team had attended many national tournaments including China Nationals, Asia Oceanic Ultimate Championships and the World Ultimate & Guts Championships (WUGC), in which they have won at the China National Championship in 2009 and 2011.<sup>2</sup>

Despite its increasing popularity, there has been many risk factors associated with this sport.<sup>3</sup> The game involves movements shared in many other sports, such as running, cutting, jumping,

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pivoting and laying out (i.e. diving with an outstretched hand) (Fig. 1). As it has been defined as a non-contact sport, research interest is mainly focused on prospective injury epidemiology or injury prevention and management research.<sup>4</sup>

In addition, most epidemiological studies on Ultimate were mainly done in the United States and Europe, including professional<sup>4,5</sup> and collegiate<sup>6,7</sup> level players. However, there is currently no epidemiological study reporting on Asian players. Hess et al.<sup>4</sup> evaluated the injury rates, profiles, and associated factors of sixteen all male teams from the American Ultimate Disc League professional ultimate teams during the 2017 season. Of the respondents, most injuries affected the lower extremity (72%). The most common injuries were thigh-muscle strains (12.7%) and ankle-ligament sprains (11.4%). Whereas in a descriptive epidemiology study conducted by Swedler et al., it showed injury patterns to college ultimate players were similar to those for athletes in other National Collegiate Athletic Association sports.<sup>6</sup> Similarly, Akinbola et al. reported a majority of Ultimate injuries were involved with the lower extremity.<sup>7</sup>

As most of these descriptive studies were conducted in the US,<sup>3–8</sup> UK<sup>9</sup> and Europe,<sup>10</sup> there is currently no epidemiology literatures documenting the injury risk of Ultimate in other popularity rising Asian countries/regions, such as Hong Kong. The understanding on the injury risks and associated factors on Ultimate can benefit a better injury rehabilitation and prevention of recurrence or exacerbation for the players in Hong Kong. Herein, the purpose of this study is to conduct a cross sectional description on the injury prevalence of Ultimate Frisbee players in Hong Kong.

## 2. Materials and methods

### 2.1. Subject recruitments

This is a cross-sectional study retrospectively recording injuries from Ultimate in 2019 in Hong Kong through an online survey. This study was conducted using the online survey platform Qualtrics. Participants were recruited through the Hong Kong Flying Disc Federation. Eligible participants include all Ultimate players who had participated in at least one tournament in 2019, and/or members of Hong Kong based teams in a professional, club, college, high school or recreational league. Exclusion criteria is when an Ultimate player is below the age of 18 years old. Institutional review board approval was obtained prior to data collection. Informed consent was also obtained from all individual participants prior to the start of this study.

### 2.2. Data collection

The questionnaire used is an adaptation of Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC-H2) survey<sup>11</sup> and International Olympic Committee (IOC) consensus statement (Supplementary Table 1) and the survey was conducted on the platform Qualtrics from June 3–16 2020. No personally identifiable information was collected. As in Hong Kong, there was 119 Ultimate players registered in HKFDF in 2019. Herein, sample size of 92 or more surveys is needed to have a 95% confidence level, a 5% margin of error, and an estimated injury proportion of 50% in all ultimate players in Hong Kong.



Fig. 1. Elements of Ultimate Frisbee. These includes: (A, B) back hand throw, (C, D), forehand throw, (E) jumping, and (F) laying out.

### 2.3. Definition of injury and exposure

A reportable injury can be classified into major or minor injury. Major injury is defined as time loss (i.e. injury restricting athlete participation for 1 or more days beyond day of injury), and/or medical attention was required on site.<sup>4</sup> Minor injury is defined as any injury considered to be a reduction in normal state of full health, irrespective of its consequences on sports participation or performance, or whether any medical attention was sought.<sup>12</sup> Onset of injury can be classified as new, recurrent, and exacerbated. New, defined as first time injury occurring in the location or new injury mechanism; Recurrent, defined as injury in the same location after full recovery and return-to-sport; exacerbated, defined as injury of an existing and not recovered condition.<sup>4</sup> Athlete exposure (AE) is defined as 1 athlete participating in 1 session of training or 1 game in tournaments (warm up and cool down sessions included). Injury incidence rates (IRs) were calculated as injuries per athlete-exposure (AE), in which they are expressed as the number of reported cases per 1,000 session or game (reported cases/total number of sessions or game\*1,000). While incidence rate ratios (IRRs) will be used to compare between genders and training injuries versus competition injuries. In addition, injury location, type, onset, event, mechanism, and associated factors were analysed in this study. These variables were chosen to better understand the prevalence and characteristics of injury, as well as its relationship with various subgroup factors.

### 2.4. Statistical analysis

Data from Qualtrics was downloaded using Microsoft Excel (Microsoft Corp, Redmond, WA). The data were cleaned and ordered using SPSS for Windows 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistical analysis was performed to catalogue injury types and rates for injuries reported by participants. Responses with missing data were excluded. The injury prevalence calculation included the defined major and minor injuries in the study. Data was collected, exported and downloaded from Qualtrics Survey Software. Pearson chi-square analyses were performed to compare for proportions between gender and regional distribution of injuries. Statistical significance was set at  $p \leq 0.05$ .

## 3. Results

### 3.1. Participants

119 active Ultimate players were invited. A total of 90 responses recorded, 31 entries of which were excluded due to incompleteness or ineligibility. The overall response rate was 75.6%. 59 entries were eligible for analysis. The study demographic ranged from 18 to 55 years old. 66.1% participants are male and 33.9% female (Table 1). The mean height and weight is  $172.0 \pm 8.75$  cm and  $67.6 \pm 11.8$  kg, respectively. Whereas, the mean body mass index (BMI) is  $22.6 \pm 2.68$ . All but one participant trained for more than a year for

**Table 1**  
Demographic of participants.

Parameters	Total (n = 59)	Male (n = 39)	Female (n = 20)
Age Range (years)	18–55	18–55	18–55
Height (cm)	$172.0 \pm 8.8$	$177.2 \pm 5.9$	$163.3 \pm 5.4$
Weight (kg)	$67.6 \pm 11.8$	$72.5 \pm 11.1$	$58.0 \pm 5.4$
BMI (kg/m <sup>2</sup> )	$22.6 \pm 2.7$	$23.1 \pm 3.1$	$21.7 \pm 1.4$
Ethnicity	Chinese	Chinese	Chinese

BMI: Body mass index.

Ultimate. The difference in injury incidence between men and women is not statistically significant (IRR = 1.16, 95% confidence interval (CI) = 0.63, 2.14) (see Table 2).

### 3.2. Injury rates

The injury prevalence is 62.7%. 54 injuries were observed over 9412 h of AE. The injury incidence is 5.74 injuries per 1000 h of AE. The risk of injury during training is 3 times less compared to during tournament (IRR = 0.33, 95% CI = 0.18, 0.60,  $p < 0.01$ ) (Table 1). In the 2019 seasons, more participants suffer a single injury (59.5%), while the rest sustained multiple injuries (40.5%).

### 3.3. Injury location

The detailed anatomical locations of injuries can be broadly grouped into 3 groups: 1) head, neck, and trunk, 2) upper limb and 3) lower limb (Table 3). Majority of reported injuries are situated in the lower limb (61.1%). The most common being the foot and ankle (27.8%), followed by knee (24.1%), lower back (14.8%) and hand and wrist (9.3%). Whereas, the majority of reported injuries arise from the joints and ligaments (44.4%), followed by muscles and tendons (33.3%).

### 3.4. Injury severity

According to the definition of injury severity used in this study, most are major injuries (72.2%) (Table 4). The most reported mechanism of injury is cutting (23.7%), followed by jumping (19.6%), pivoting (11.3%), stepping on uneven surface (11.3%), and laying out (10.5%). There is a higher injury risks in tournaments from laying out (IRR = 0.04, 95% CI = 0.01, 0.30,  $p < 0.01$ ) and jumping/landing from jump (IRR = 0.30, 95% CI = 0.11, 0.86,  $p = 0.02$ ). The difference in occurrence of mechanisms of injuries are not statistically significant in the younger and older age group. Majority of recorded injuries are new (57.4%), followed by recurrent (29.6%) and exacerbation (13.0%) of previous injuries. Although most reported injuries were not directly resulted from collision (49.1%), there was still a significant proportion being indirectly associated with collision, such as improper landing from laying out (17.5%) and collision with another athlete (15.8%). Injury occurrence between males and females is not significant difference for injury location, nature, severity, mechanism, onset and associated factors.

## 4. Discussion

This is the first epidemiological study on the injury risks of Ultimate players in Hong Kong. As a sport with rising popularity in Hong Kong, this study is of paramount importance to collect epidemiological data for implementation of tailored prevention and/or rehabilitation strategies.

### 4.1. Injury rate and severity of different risk factors

Ultimate is a physically demanding sport with high cardiovascular loading, which players often fatigue at the end of each half during a game.<sup>13</sup> Similar to another study,<sup>4</sup> injury rates are higher in tournaments than training in Hong Kong. With an intensive tournament schedule, the players are predisposed to higher risks of injuries from this cutting-intensive sport. Quadriceps and hamstring are essential to generating power in sprinting and jumping. Strength training for those muscle groups is essential in tournament preparation. Layout techniques should also be trained for a safe execution.

Major injuries are reported to be 72.2% among participants.



**Table 2**  
Injury incidence, athlete-exposures (AEs), injury incidence rates, and injury rate ratios by sex and by setting.

Category and Value	Injury Incidence	AEs <sup>a</sup>	Injury Incidence Rate (per 1000 AEs) <sup>a</sup>	Injury Rate Ratio (95% Confidence Interval)
Total	54	9412	5.74	N/A
<i>Gender</i>				
Male	40	6692	5.98	1.16 (0.63, 2.14)
Female	14	2720	5.15	
<i>Setting</i>				
Training	23	7228	3.18	0.33 (0.18, 0.60)**
Tournament	21	2184	9.62	
Missing	10	/	/	
<i>Setting by sex</i>				
Men training	18	5148	3.50	
Men tournament	15	2080	7.21	0.49 (0.24, 0.96)*
Women training	5	1544	3.24	
Women tournament	6	640	9.38	0.35 (0.11, 1.14)

Abbreviation: N/A, not applicable.

\* Incidence rate ratio significant at the  $p \leq 0.05$  level.

\*\* Incidence rate ratio significant at the  $p \leq 0.01$  level.

<sup>a</sup> Dashes indicate comparisons that are not testable.

**Table 3**  
Injury location<sup>a</sup>.

Category and Value	Injury Incidence	AEs	Injury Incidence Rate (per 1000 AEs)	Injury Rate Ratio (95% Confidence Interval)
<i>Head, neck, and trunk</i>				
Male	8	6692	1.20	0.65 (0.21, 1.99)
Female	5	2720	1.84	
<i>Upper limb</i>				
Male	7	6692	1.05	2.85 (0.35, 23.14)
Female	1	2720	0.37	
<i>Lower Limb</i>				
Male	25	6692	3.74	1.27 (0.57, 2.82)
Female	8	2720	2.94	

<sup>a</sup> Incidence rates per 1000 athlete-exposures for Men's and Women's Divisions, incidence rate ratios for Men's/Women's Divisions.

**Table 4**  
Injury severity<sup>a</sup>.

Category and Value	Injury Incidence	AEs	Injury Incidence Rate (per 1000 AEs)	Injury Rate Ratio (95% Confidence Interval)
<i>Major</i>				
Male	28	6692	4.18	1.04 (0.51, 2.08)
Female	11	2720	4.04	
<i>Minor</i>				
Male	12	6692	1.79	1.63 (0.46, 5.77)
Female	3	2720	1.10	

<sup>a</sup> Incidence rates per 1000 athlete-exposures for Men's and Women's Divisions, incidence rate ratios for Men's/Women's Divisions.

30.8% did not attend to any medical personnel. Injury rehabilitation is equally as important as injury prevention. Ultimate players in Hong Kong has a low rate of consulting physician or physiotherapist for diagnosis, which could delay healing and impair athletic performance. This study has found a higher proportion of recurrent injuries compared to professional Ultimate frisbee players where strong medical support is available.<sup>4</sup> Although resting, taping and orthosis use are helpful, the involvement of team physician or physiotherapist can be beneficial for proper diagnosis and rehabilitation planning.

#### 4.2. Comparison of injury between Hong Kong and western countries

The overall injury rate of injury in Hong Kong is 2 times less than that of collegiate Ultimate<sup>19</sup>, and 5 times less than professional Ultimate players in United States.<sup>4,6</sup> Lower intensity and under-reporting could be a cause of the difference. The same equivalent unit of athlete exposure in a professional league represents a

significantly different intensity and duration of play, leading to more injuries.<sup>4</sup> Tournaments in Asia, are often held as an intensive 2-days tournaments with multiple games being played per day. The combination of increased intensity and playing time with inadequate preparation will lead to fatigue and injury during tournaments. Due to the intense nature and high injury risk, host organizations of tournaments could also consider to limit the number of games per day or set a minimum squad size to ensure adequate rest for injury prevention.

Collision injuries in Ultimate has also been the topic of concern in recent years. In collegiate level and professional Ultimate, 30% of injuries were caused by collision, which were higher than we reported in Hong Kong (15.8%).<sup>4,6</sup> Avoidance of collision and strategic use of body blocking require both agility, awareness on the field from training as well as on field judgement. The change in rules was documented to effectively decrease in collision injuries in soccer.<sup>12</sup> The United States of America Ultimate (USAU) and the World Flying Disc Federation (WFDF) modified the rule of “dangerous play” in attempt to prevent collision injury. Collision from improper landing

of laying out was noted to cause 17.5% injuries with locations including most commonly knee, followed by wrist, forearm, lower back, neck and shoulder. While it is more likely for Ultimate players in Hong Kong to suffer from a new injury, comparing with professional Ultimate players, the chances of having a recurrent or exacerbation is 1.5 times more.<sup>4</sup>

#### 4.3. Comparison of injury rate between Ultimate Frisbee and other sports

While the injury incidence rates reported in Ultimate Frisbee in Hong Kong is 5.74 injuries in 2019, injury incidence rate in professional soccer player is recorded to range from 2.48 to 9.40 injuries per 1,000 h of AE, predominantly lower limb injuries including sprains, strains, and contusions.<sup>14</sup> On the other hand, professional basketball players are noted to have injury rate of 19.1 per 1,000 AE, predominantly lower limb and lumbar spine injuries, including sprains, strains, inflammations, and contusions.<sup>15</sup>

With a similar sport mechanism in soccer and Ultimate Frisbee involving body movements like running, cutting and jumping, the injury incidence rates and locations are more comparable than that of basketball.

#### 4.4. Limitations of current study

The limitations of this study include retrospective and self-reporting data. Participants were invited to complete a questionnaire to report health concerns from 2019. There is a significant recall bias on the details of the injury. The athlete exposure is also an approximation calculated from a self-reported average training session per week and tournament games played in 2019. The prevalence and recorded athlete exposures could also be an inaccurate reflection of normal training schedules due to the political unrest and instability in the city.

### 5. Conclusion

The injury prevalence in Ultimate Frisbee in Hong Kong was found to occur predominantly at the lower extremities. Majority of ultimate injuries are major, requiring on site medical attention and/or resulted in time loss. Tournaments are found to have a significantly higher injury rate when compared with training. Individual injury mechanisms can also be addressed with tailored intervention in attempt to decrease the occurrence and risk of injuries. The data obtained in this study can be used as a baseline for comparison with future intervention.

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#### Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.asmart.2021.07.006>.

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