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A Retrospective Self-Reported Audit of Injuries Amongst Grappling Athletes Competing in the United Kingdom

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ABSTRACT

Purpose: This study aimed to estimate the incidence, prevalence, type, and mechanism of injuries among grappling athletes in the United Kingdom (UK) across the following disciplines: Brazilian Jiu-Jitsu (BJJ), Judo, Catch Wrestling, Sambo, and Mixed Martial Arts (MMA).

Methods: A retrospective, self-reported survey, delivered via JISC online survey software, was used to record the following information for all injuries sustained over the previous 12-month period: mechanism of injury, environment, severity, recurrence and body region. Additionally, injury diagnosis was reported where possible. Injury incidence for training exposure was calculated based on hours trained per week, while competition exposure was based on the number of bouts participated in during the year. One variable chi-square tests (X^2) were used to calculate if observed values were significantly different from expected values.

Results: A total of 341 grappling athletes, 243 males and 97 females, with one participant preferring not to state gender (32 ± 9.3 years), completed the study over a 3-month period. The competition incident rates (IR) (24.16/1000 AE) were significantly higher than training (2.97/1000 AE). The knee was the most frequently injured site (24.5%). Ligament sprains were the most commonly diagnosed injury (24.3%). Most injuries occurred during practice sparring (65.8%), with the leading mechanisms being submission attempts and takedowns. Major injuries (>28 days recovery) accounted for 49.5% of all cases. BJJ exhibited the highest injury rate (3.49/1000 AE); patterns varied by discipline and gender.

Conclusion: Grappling sports pose a substantial risk of injury, particularly to the knee. Structured training, medical support, and tailored injury risk reduction programs should now be explored to enhance athlete safety.

Keywords: Grappling, Epidemiology, Athletic Injury, Brazilian jiu-jitsu

INTRODUCTION

In the United Kingdom (UK), the sport of grappling can be traced back to Celtic wrestling, which pre-dated the Roman occupation[1]. Over time, this developed into distinct regional styles such as Cumberland and Westmorland Wrestling, Scottish Backhold Wrestling, and Cornish Wrestling[2]. Northern English styles of wrestling, such as Lancashire wrestling, have citations in the literature dating from the 1300s[3]. Later, this style became Catch wrestling and was featured in the 1904 Olympic Games. Catch wrestling is the primary influence for many modern grappling sports, notably freestyle, professional wrestling and Brazilian Luta Livre[4]. During the last decade, other grappling sports, such as Brazilian Jiu-jitsu (BJJ), Judo and Sambo, have become popular in Britain[5], with Judo participation rates growing from 27,000 to 33,000

from 2022 to 20235. The number of registered BJJ gyms in the UK has grown rapidly from 12 in 2009 to 320 in 2020[6].

Although each grappling sport has different rulesets, they all require opponents to be taken to the floor through takedowns or upper-body throws. A grappler can win by submitting their opponent with a choke or applying torsion to a joint[7]. In Judo and Catch wrestling, grapplers can win by pinning their opponent's shoulders to the floor, in addition to submissions[8]. Despite the long history of Catch wrestling and the rapid growth of BJJ and Judo[9] The current injury trends in this discipline are not known in grapplers who train and compete in the UK.

Due to the worldwide popularity of the Judo discipline, numerous epidemiology studies have been conducted. A recent systematic review collating injury rates from 25 studies involving 361,581 participants competing in Judo tournaments reported an injury incidence range of 4.2 to 115 injuries/ 1000 athletic exposure (AE)[10]. Lapaeva and Tabakov's (2021) research used a mixed sample of 60 Sambo and Judo athletes and established that the knee joint has the highest injury prevalence at 38.3%. In a recent UK study, injury rates (IR) for freestyle wrestling were reported as 42.01/1000 AE for competition and a training IR of 2.92/1000h[11]. In MMA, grappling injury data is combined with injuries caused by strikes, resulting in a high competition injury rate (IR) of 246.4/1000 (AE). Although an IR for grappling injuries in MMA is unknown, there is data available showing the rate of match stoppages caused by a grappling submission, 228.6/1000AE[12]. Despite the growing participation rates in BJJ, only two studies report the competition IR. Kreiswirth et al. (2009)[13] monitored 951 athletes from the 2009 no-gi world championships in California; the study reported an IR of 24.9 injuries/ 1000 AE[13]. Scoggin et al. (2014) study recorded injury data from 2,511 BJJ matches in the United States of America (USA) between 2005 and 2011. This resulted in an IR of 9.2/100 AE. Despite the lack of IR data, there are numerous BJJ studies that state injury prevalence, with studies reporting the knee as the most frequently injured anatomical site, with estimates between 20.8% to 81.1% of all injuries[13-20]. Obtaining injury data helps sports science, medical staff and coaches to understand injury trends and subsequently implement injury risk reduction strategies to enhance athlete safety. Collating all grappling sports together will allow for standardisation in the reporting and categorisation of injury across the different styles, permitting accurate comparisons to be made. Therefore, the primary aim of this study will be to estimate the injury incidence and prevalence amongst grappling athletes competing in the UK.

MATERIALS AND METHODS

A retrospective, self-reported study design was used to estimate the frequency, type, and mechanism of musculoskeletal injuries sustained by a cohort of grapplers based in Great Britain over a 12-month period. The study was approved by the Leeds Beckett University School of Health ethics committee (ethics number 135704). Data collection took place between August and December 2024.

Procedure

To be eligible for inclusion in the study, respondents had to be >18 years old and identify themselves as a grappling athlete who had participated in BJJ, Judo, Catch wrestling, Greco-roman wrestling, and mixed martial arts (MMA) grappling for over 12 months prior to completing the injury survey. To reduce selection bias, the survey was promoted at four grappling events: the United World Wrestling (UWW) National Grappling Championship, the British Judo Championships, the Catch Wrestling World Championships, and the Yorkshire BJJ Open. It was also sent electronically to 50 grappling clubs around the UK. The British Wrestling Association and the English Mixed Martial Arts Association also shared the study information electronically with their members via email. A duplicate version of the survey can be viewed via this link: https://app.onlinesurveys.jisc.ac.uk/s/school-of-health/a-retrospective-self-reported-audit-of-injuries-amongst-grapp-1.

All respondents were required to read the participant information and provide informed consent before gaining access to the survey. The survey was void of key identifying information such as names, dates of birth and address. Self-reported injury data was collected using a survey method, which could be completed online via a secure JISC online survey (Version 3). Data was then transposed from the secure JISC platform onto a password-protected Excel file and stored in a cloud-based system, accessible only by the lead researcher (JB). The data was electronically shared via this cloud-based system with the research team (ET, AJ) only.

Definitions and Categorisation

Participant demographics, including age, weight, height, and sex (Male/Female/non-Binary), were collected at the start of the questionnaire. Participants then chose their grappling style from the following options BJJ, Judo, Sambo, Catch wrestling, Greco-Roman wrestling, and MMA grappling. To calculate injuries per hours of exposure (h), participants recorded the number of weekly hours each athlete spent performing grappling-based training[21,22]. AE was used to calculate competition IR. Participants were also required to state the number of competitive bouts each athlete competed in the previous 12 months, with each bout equating to one AE. AE was defined as "one athlete participating in a competition during which they are exposed to a possibility of athletic injury"[23]. Athletes were asked to complete twenty two questions, with an additional thirteen questions for every further injury reported. All data was self-reported by the athletes.

The definition of injury was taken from the International Olympic Committee (IOC) consensus statement: "tissue damage or other derangements of normal physical function due to participation in sports, resulting from the rapid or repetitive transfer of kinetic energy"[24]. In addition, clarification was sought as to whether the injury was defined as a 'time loss' injury or a medical attention injury[23]. A medical attention injury refers to those which require assessment from a healthcare professional and may or may not relate to time loss. Time loss was defined as "Any physical complaint sustained by a grappler that results from grappling training or a grappling competition that led to the grappler being unable to take full part in future grappling training or grappling competition"[11]. The definition of injury and time loss was provided to the participants at the start of the questionnaire.

Grapplers were asked to recall the type of training being undertaken when the injury occurred. Grappling-based training will be defined as "any grappling, practice drilling, practice sparring, and Sport-specific conditioning"[11]. Competition will be defined as "any competitive match outside of the training environment, either as part of a tournament or a single match-up"[11]. Therefore, the options for injury environment were split into practice drilling, practice sparring, competition matches, and grappling-specific conditioning.

Body region and recurrence sub-categories were taken from the IOC consensus statement[24]. To obtain further information on Injury diagnosis, respondents were asked to state if a qualified practitioner had diagnosed the injury and, if so, their profession, if known. This allowed for further analysis of medically diagnosed injuries[11,25]. The injury type sub-category used for this further analysis was adapted from previous grappling studies[10,11,18,26] so that direct comparisons to previous research could be made. The method for recording mechanisms of injury (MOI) was developed from injury studies in BJJ, Judo and wrestling[10,15,27-29]. They were categorised as follows: I was taken down by my opponent, I was taking my opponent down, my opponent was attempting a submission, I was attempting a submission on my opponent, I was passing guard, my opponent was passing my guard, hand fighting, escaping, reversal, riding, unknown and other. The severity of injury was measured by time loss (TL) using whole days. To establish this, respondents were asked to provide the date of the injury and the date they returned to grappling practice or competition. The severity of injury was then tallied and put into four TL categories: slight (0-3 days), minor (4-7 days), moderate (8-28 days), and major (>28 days), as per previous injury studies across multiple sports[11,30,31]. The categories for recurrence of injury were chosen so that a comparison with the data from previous wrestling studies can be made[11]. These categories are 'no previous injury at the site, reinjury (exacerbation of current injury), recurrent (< 2 months), late recurrence (2-12 months), delayed recurrence (>12 months)'.

Statistical Analysis

The data was analysed once the withdrawal period for the last response had passed. Descriptive statistics were expressed as tally counts and percentages with 95% confidence intervals (CI). One variable chi-squared tests (X^2) were used to assess whether observed values significantly differed from expected values, which were calculated using a percentage determined by the number of options in each category. The following variables were tested: body region, injury diagnosis, mechanism of injury and severity of injury. Statistical package for the Social Sciences (SPSS) version 29 was used for all descriptive and inferential statistics, with statistical significance set at $p \leq 0.05$. The Injury incidence is calculated per 1000 hours (h) of grappling training with 95% confidence intervals (95% CI)[21,22]. Fisher F and chi-square functions were used to calculate lower and upper binomial confidence intervals[32]. The injury incident rate confidence intervals were

calculated using the equations upper Limit = (1000 / total exposures) (total number of injuries + (1.96 x square root of total number of injuries)) and lower Limit = (1000 / total exposures) (total number of injuries - (1.96 x square root of total number of injuries)).

Overall Injury incident rate = The total number of injuries/Yearly grappling exposure hours x 100021
Most previous studies in wrestling, BJJ and Judo have reported competition injury data via AE. This may be due to the short nature of bouts, with Judo bouts lasting 4 minutes and Greco-Roman wrestling lasting two 3-minute rounds. However, unlike association football and rugby, which have a set duration, matches can be played prior to the set times if a successful submission or pin is secured. Due to this, the incidence of injury for competition was calculated using AE, with one bout equating to one AE. Therefore, competition exposure was calculated using the equation:

Competition injury incident rate = the total number of competition injuries/AE for the year x 1000[33].

RESULTS

Overall, three hundred and forty-one grapplers (32 ± 9.3 years, 80.5 ± 19.3 kg, 175.3 ± 10cm) responded to the survey. All anthropometrics are shown in Table 1. Two hundred and sixty respondents sustained an injury, totalling three hundred and eighty-three injuries. One hundred and six of the respondents sustained two or more injuries in the previous 12 months, with fourteen (n=14) sustaining three or more and three sustaining four injuries in the period. Two hundred and forty-three of the respondents were males who reported 71% (243/341, 95% CI 66% to 76%) of all injuries, with the remaining 28% (97/341, 95% CI 24% to 34%) being females with one respondent (n=1) preferring not to state their gender.

On average, respondents trained for 6.52 (± 4.30) hours per week and competed in 7.50 (± 12.13) bouts per year. The IR for training was 2.97/1000 AE (95% CI 2.65 to 3.30) and 24.16/1000 AE (95% CI 15.66 to 32.67) for competitions. IR rates split between disciplines and genders can be seen in Table 5.

Body region

The knee was the most common injury site, accounting for 24.5% (95% CI 20 to 29%), followed by the shoulder/clavicle (14.1%, 95% CI 11% to 18%) and the foot/heel/toe (9.4%, 95% CI 7% to 13%). A one-variable chi-squared test found a significant difference between expected and observed values in anatomical sites (X^2 (17) = 423.143, p = ≤0.001). Table 2 presents the frequencies for each body region.

Injury diagnosis

It was reported that an allied health professional diagnosed 59.2% of the injury entries. The most frequent types of injury were ligament sprains (24.3%, 95% CI 19% to 30%), followed by fractures (18.9%, 95% CI 14% to 24%) and 'other' (15%, 95% CI 11% to 20%). A significant difference between expected and observed values in injury type was seen in injury type (X^2 (10) = 142.65, p = ≤0.001). Table 2 shows the frequencies for each diagnosis.

Table 1. Anthropometric characteristics of the respondents with mean and standard deviation.

Sample (discipline and sex)	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m²)
Combined sample				
Overall (n=341)	32 ± 9.3	80.5 ± 19.3	175.3 ± 10	26.2
Male (n=243)	32.5 ± 9.8	86 ± 19 kg	179.1 ± 13.3	26.8
Female (n=97)	30.8 ± 7.6	66.6 ± 11.4	162.5 ± 14.3	25.2
Grappling disciplines				
Brazilian Jiu-jitsu (n=217)	32.2 ± 8.5	77.9 ± 19.6	173.6 ± 15.5	25.8
Judo (n=56)	34.1 ± 12.8	84.8 ± 17.8	176.4 ± 9.9	27.3
MMA Grappling (n=35	25.3 ± 5.6	79.4 ± 16.7	176.7 ± 9.8	25.4
Catch wrestling (n=24)	35.8 ± 6.6	89.6 ± 14.2	172.0 ± 30.8	30.3
Sambo (n=8)	29.9 ± 6.2	91.0 ± 13.8	179.7 ± 4.8	28.2
Greco-Roman Wrestling (n=2)	36.5 ± 6.4	116.5 ± 54.4	183.0 ± 1.4	34.8

Table 2. Distribution of injuries by body region and diagnosis, MOI, and Environment. Presented as percentage (%) (frequency).

Body Region	Combined Sample	Judo	BJJ	Catch Wrestling	MMA Grappling	Greco Roman Wrestling	Sambo
Abdomen	0.5 (2/383)	0 (0/56)	0.8 (2/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Ankle	7.8 (29/383)	10.7 (6/56)	7.1 (19/266)	7.1 (2/28)	6.9 (2/29)	0 (0/1)	0 (0/3)
Elbow	6.8 (26/383)	1.8 (1/56)	7.5 (20/266)	3.9 (1/28)	13.9 (4/29)	0 (0/1)	0 (0/3)
Fingers	6.3 (24/383)	7.1 (4/56)	7.1 (19/266)	3.9 (1/28)	0 (0/29)	0 (0/1)	0 (0/3)
Foot/heel/toe	9.4 (36/383)	7.1 (4/56)	11.3 (30/266)	0 (0/28)	6.9 (2/29)	0 (0/1)	0 (0/3)
Head/face/lips/tongue	3.9 (15/383)	7.1 (4/56)	2.6 (7/266)	14.3 (4/28)	0 (0/29)	0 (0/1)	0 (0/3)
Hip/groin	1.8 (7/383)	3.6 (2/56)	1.9 (5/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Knee	24.5 (94/383)	19.6 (11/56)	24.1 (64/266)	32.1 (9/28)	27.6 (8/29)	0 (0/1)	67 (2/3)
Lower arm	3.1 (12/383)	1.8 (1/56)	2.6 (7/266)	10.7 (3/28)	3.5 (1/29)	0 (0/1)	0 (0/3)
Lower back/sacrum/pelvis	4.4 (17/383)	3.6 (2/56)	4.5 (12/266)	3.9 (1/28)	6.9 (2/29)	0 (0/1)	0 (0/3)
Lower leg/Achilles	0.8 (3/383)	0 (0/56)	1.1 (3/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Neck/cervical spine	7.3 (28/383)	5.4 (3/56)	6.4 (17/266)	17.9 (5/28)	10.3 (3/29)	0 (0/1)	0 (0/3)
Shoulder/clavicle	8.7 (54/383)	14.5 (8/56)	13.5 (36/266)	3.9 (1/28)	24.8 (7/29)	0 (0/1)	33.3 (1/3)
Sternum/rib	5.5 (21/383)	10.7 (6/56)	5.3 (14/266)	3.9 (1/28)	0 (0/29)	100 (1/1)	0 (0/3)
Thigh	0.5 (2/383)	0 (0/56)	0.8 (2/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Thumb	1 (7/383)	5.4 (3/56)	1.5 (4/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Upper arm	0.5 (2/383)	1.8 (1/56)	1.1 (3/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Upper back	0.5 (2/383)	1 (1/56)	0.8 (2/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Wrist	0 (0/383)	0 (0/56)	0 (0/266)	0 (0/28)	0 (0/29)	0 (0/1)	0 (0/3)
Diagnosis							
Muscle strain	9.7 (22/226)	0 (0/36)	8.8 (13/148)	22.2 (6/27)	21.4 (3/14)	0 (0/1)	0 (0/3)
Ligament sprain	24.3 (55/226)	25 (9/36)	24.3 (36/148)	26 (7/27)	21.4 (3/14)	0 (0/1)	0 (0/3)
Tendinopathy	2.2 (5/226)	2.8 (1/36)	2.7 (4/148)	0 (0/27)	0 (0/14)	0 (0/1)	0 (0/3)
Tendon rupture	6.6 (15.226)	5.6 (2/36)	6 (9/148)	7.4 (2/27)	7.1 (1/14)	0 (0/1)	0 (0/3)
Fracture	18.9 (42/226)	19.4 (7/36)	19.6 (29/148)	7.4 (2.27)	28.6 (4/14)	0 (0/1)	0 (0/3)
Dislocation	9.7 (22/226)	13.9 (5/36)	10.8 (16/148)	3.7 (1/27)	0 (0/14)	0 (0/1)	0 (0/3)
Cartilage tear	8.4 (19/226)	8.3 (3/36)	8.8 (13/148)	7.4 (2/27)	7.1 (1/14)	0 (0/1)	0 (0/3)
Bruising (Contusion)	1.8 (4/226)	0 (0/36)	1.4 (2/148)	3.7 (1/27)	0 (0/14)	0 (0/1)	0 (0/3)
Laceration (Cut)	1.3 (3/226)	0 (0/36)	1.4 (2/148)	3.7 (1/27)	0 (0/14)	100 (1/1)	0 (0/3)

Abrasion (e.g. mat burn)	0.0 (0/226)	0 (0/36)	0 (0/148)	0 (0/27)	0 (0/14)	0 (0/1)	0 (0/3)
Concussion	2.2 (5/226)	5.6 (2/36)	0.7 (1/148)	3.7 (1/27)	0 (0/14)	0 (0/1)	0 (0/3)
Other	15.0 (34/226)	16.7 (6/36)	15.5 (23/148)	11.1 (3/27)	14 (2/14)	0 (0/1)	0 (0/3)
Injury Mechanism							
I was taken down by my opponent	19.1 (73/383)	33.9 (19/56)	12.8 (34/266)	29 (8/28)	31 (9/29)	100 (1/1)	67 (2/3)
My opponent was attempting a submission.	19.8 (76/383)	26.8 (15/56)	7.9 (21/266)	25 (7/28)	13.8 (4/29)	0 (0/1)	33.3 (1/3)
I was taking my opponent down	11.7 (45/383)	3.6 (2/56)	23.3 (62/266)	17.9 (5/28)	10.3 (3/29)	0 (0/1)	0 (0/3)
I was attempting a submission on my opponent.	3.9 (15/383)	5.4 (3/56)	4.1 (11/266)	0 (0/28)	6.9 (2/29)	0 (0/1)	0 (0/3)
I was passing guard	0.5 (18/383)	0 (0/56)	6.4 (17/266)	0 (0/28)	3.5 (1/29)	0 (0/1)	0 (0/3)
My opponent was passing my guard.	0.5 (19/383)	0 (0/56)	6.8 (18/266)	3.9 (1/28)	0 (0/29)	0 (0/1)	0 (0/3)
Escaping (a pin or an unwanted position)	6.3 (43/383)	5.4 (3/56)	13.2 (35/266)	3.9 (1/28)	13.8 (4/29)	0 (0/1)	0 (0/3)
Hand fighting	3.4 (13/383)	5.4 (3/56)	1.5 (4/266)	21 (6/28)	0 (0/29)	0 (0/1)	0 (0/3)
Reversal	0.5 (19/383)	1.8 (1/56)	6 (16/266)	0 (0/28)	6.9 (2/29)	0 (0/1)	0 (0/3)
Unknown cause	8.1 (31/383)	3.6 (2/56)	10.5 (28/266)	0 (0/28)	3.5 (1/29)	0 (0/1)	0 (0/3)
Other	8.1 (31/383)	14.3 (8/56)	7.5 (20/266)	0 (0/28)	10.3 (3/29)	0 (0/1)	0 (0/3)
Environment							
Sparring	65.9 (252/383)	14.3 (8/56)	17.3 (46/266)	61 (17/28)	65.5 (19/29)	0 (0/1)	100 (0/3)
Drilling	17.2 (66/383)	55,4 (31/56)	68.9 (182/266)	21 (6/28)	20.7 (6/29)	0 (0/1)	0 (0/3)
Competition	14.6 (56/383)	28.6 (16/56)	12 (31/266)	14 (4/28)	13.8 (4/29)	100 (1/1)	0 (0/3)
Sport-specific conditioning	2.3 (9/383)	1.8 (1/56)	2.6 (7/266)	3.9 (1/28)	0 (0/29)	0 (0/1)	0 (0/3)

Mechanism of Injury and Environment

The leading MOI of this study was 'an opponent attempting a submission' (19.8%, 95% CI 16% to 24%), followed by 'being taken down by the opponent' (19.1%, 95% CI 15% to 23%) and 'taking an opponent down' (11.7%, 95% CI 9% to 15). A one-variable chi-squared test found a significant difference between expected and observed values in the mechanism of injury (X^2 (10) = 143.78, p = ≤0.001). It was established that 65.8% (95% CI 61% to 71%) happened during practice sparring, followed by practice drilling (17.2%, 95% CI 14 % to 21%) and competition (14.6%, 95% CI 11% to 19%). A one-variable chi-squared test found a significant difference between expected and observed values in the environment of injury (X^2 (3) = 359.32, p = ≤0.001). Table 2 shows the frequency of each MOI and environment.

Recurrence and Severity of Injury

The respondents chose 'not recurring' as the leading injury recurrence status (43.1%, 95% CI 38% to 48%) followed by 'Yes - an ongoing injury' (15%, 95% CI 11% to 19%) and 'Yes - the same injury that recurred between 2-12 months' (8.4%, 95% CI 6% to 12%).

The leading Severity of injury was Major (>28 days), resulting in 49.5% (95% CI 44% to 55%) of all injuries, followed by Slight (26.3%, 95% CI 22% to 31%) and Moderate (19.4%, 95% CI 15% to 24%). There were 11 (11/383) injuries for which the respondents could not confidently recall time loss. A significant difference between expected and observed values in the severity of injury was seen (X^2 (3) = 154.54, p = ≤ 0.01). 26.6% (102/383, 95% CI 22% to 31%) of respondents went to an accident and emergency with their injuries. It was reported that respondents continued training in some form for most injuries (62.4%, 239/383, 95% CI 57% to 67%). Table 3 shows the number of injuries by severity category and recurrence.

Sex

There were 243 male respondents, making up 71% of the overall sample (243/341). Of the 243 participants, 182 stated that they had been injured in the previous 12 months, and 80 of the 243 respondents (32.9%) reported two or more injuries in that period. This resulted in a training IR of 2.84/1000h (95% CI 2.47 to 3.21) and a competition IR of 21.26/1000 AE (95% CI 14.31 to 28.21).

There were 97 female respondents, 77 stating to have had one or more injuries in the previous 12 months. From the 77 participants, a total of 119 injuries were reported. The training IR was 2.81/1000h (95% CI 2.26 to 3.40), and a competition IR of 22.54/1000 AE (95% CI 12.40 to 32.67) Most respondents did not recall what phase of their menstrual cycle they were in when the injury occurred, with 51.3% (61/119, 95% CI 42% to 61%) selecting 'do not know' followed by the luteal phase (23.5%, 28/119, 95% to CI 16% to 32%) and 'not applicable' (7.6%, 9/119, 95% CI 4% to 14%). The data for body regions and injury diagnosis for both sexes are presented in Table 5.

Injuries by Discipline

There were 217 respondents (32.2 ± 8.5 years, 77.9 ± 19.6 kg, 173.6 ± 15.5cm) who chose BJJ as their grappling discipline. In total, 266 injuries were reported, resulting in an overall IR of 3.49/1000 AE (95% CI 3.07 to 3.91) and a training IR of 3.14/1000h (95% CI 2.74 to 3.57). A total of 1283 competition bouts were recorded, equating to an IR of 24.16/1000 AE (95% CI 15.66 to 32.67). IR for all disciplines, excluding Greco-Roman wrestling and Sambo, due to the low sample sizes, is presented in Table 4.

There were fifty-six respondents who chose Judo as their grappling style (16%, 56/341). Thirty-eight of the respondents reported at least one injury in the previous 12 months, and eighteen respondents reported two or more injuries, resulting in a total of fifty-six injuries (56/56). The overall IR for Judo was 2.93/1000 AE (95% CI 2.17 to 3.7) with a training IR of 2.21/1000 AE (95% CI 2.85 to 4.17) and a competition IR of 16.09/1000 AE (95% CI 2.9 to 3.04).

DISCUSSION

This study aimed to estimate the injury incidence and prevalence in grappling athletes who train and compete in the UK. The competition injury incidence (24.16/1000 AE (95% CI 15.66 to 32.67) relative to training 2.97/1000h (95% CI 2.65 to 3.30). The knee was the most frequently injured body region (24.6% (94/382 95% CI 20 to 29%). A total of 59.2% (226/382) of the injuries reported were diagnosed by an allied health professional. Of these, the leading injury diagnosis was ligament sprains (24.3%, 55/226, 95% CI 19% to 30%). The leading MOI was 'an opponent attempting a submission'

Table 3. Distribution of injuries by severity and recurrence.

Severity of injury (Time missed)	Percentage (%) (Frequency)
Slight (0-3 days)	26.3 (98/372)
Minor (4-7 days)	4.7 (18/372)
Moderate (8-28 days)	19.4 (72/372)
Major (>28 days)	49.5 (184/372)
Injury recurrence	
Not a recurring injury	43.1 (165/383)
Yes - an ongoing injury	15.0 (56/383)
Yes - the same injury that recurred within 2 months	1.6 (6/383)
Yes - the same injury that recurred between 2-12 months	8.4 (32/383)
Yes - the same injury that recurred more than 12 months later	6.3 (24/383)

Table 4. Injury incident rates by grappling discipline and gender, excluding Sambo (n=8) and Greco-Roman (n=2) due to the small sample sizes.

Sample (N)	Injury incident rate (Injuries per 1000 hours of athletic exposure) and confidence intervals
Combined sample	
Training	2.97/1000h (95% CI 2.65 to 3.30)
Competition	24.16/1000 AE (95% CI 15.66 to 32.67)
Male	
Training	2.84/1000h (95% CI 2.47 to 3.21)
Competition	21.26/1000 AE (95% CI 14.31 to 28.21)
Female	3.27/1000 h (95% CI 2.68 to 3.86)
Training	2.81/1000 h (95% CI 2.26 to 3.40)
Competition	22.54/1000 AE (95% CI 12.40 to 32.67)
Grappling disciplines (Overall)	
Brazilian Jiu-jitsu	
Training	3.13/1000h (95% CI 2.7 to 3.5)
Competition	24.20/1000 AE (95% CI 15.65 to 32.67)
Judo	
Training	2.21/1000h (95% CI 2.85 to 4.17)
Competition	16.09/1000 AE (95% CI 2.9 to 3.04)
MMA Grappling	2.45/1000h (95% CI 1.56 to 3.35)
Training	2.50/1000h (95% CI 1.59 to 3.41)
Competition	17.9/1000h (95% CI 0.4 to 35.5)
Catch wrestling	
Training	3.91/1000h (95% CI 1.90 to 4.80)
Competition	35.09/1000 AE (95% CI 0.70 to 69.47)

95% CI - 95 percent confidence internal

Table 5. The prevalence rates of injury location, type, environment and MOI by sex, presented as percentage (%) (frequency).

Sex	Body region	Injury diagnosis
Males	Knee 64/262 (22.8%, 95% CI 16% to 30%) Shoulder (15.9%, 23/145, 95% to 10% to 23%) Foot (11%, 23/145, 95% CI 6% to 17%)	Ligament sprains (24.2%, 33/145, 95% CI 18% to 32%) Fractures (19.6%, 29/148, 95% CI 14% to 27%) Muscle strains (15.5%, 23/148, 95% CI 10% to 24%)
Females	Knee 30/119 (25.2%, 95% CI 18% to 34%) Shoulder 13/119 (10.9%, 95% CI 6% to 18%) Fingers 13/119 (10.9%, 95% CI 6% to 18%)	Ligament sprains 22/79 (27.8%, 95% CI 18% to 39% Fractures 18/79 (22.8%, 95% to CI 14% to 34%) Other 12/79 (15.2%, 95% CI 8% to 25%)
	Mechanism of injury (MOI)	Injury Environment
Males	An opponent attempting a submission at 57/262 (21.8%, 95% CI 17% to 27%) Being taken down by the opponent at 41/262 (15.6%, 95% CI 11% to 21%) I was taking my opponent down at 23/262 (8.8%, 95% CI 6% to 13%)	Practice sparring 273/262 (66%, 95% CI 19% to 30%) Practice drilling 42/262 (16%, 95% CI 12% to 21%) Competition 36/262 (13.7%, 95% CI 10% to 19%)
Females	Being taken down by the opponent at 23/119 (19.3%, 95% CI 13% to 28%) An opponent attempting a submission at 19/119 (15.9%, 95% CI 10% to 24%) Escaping a pin or unwanted position at 17/119 (14.3%, 95% CI 9% to 22%)	Practice sparring 76/119 (63.9%, 95% CI 33% to 48%) Practice drilling 23/119 (19.3%, 95% CI 13% to 28%) Competition 19/119 (16%, 95% CI 10% to 24%)

95% CI - 95 percent confidence internal

(19.9%, 76/382, 95% CI 16% to 24%). Injuries occurred most often during practice sparring (39.5%, 151/382, 95% CI 35% to 45%). Most injuries were not recurring (43.1%, 165/383, 95% CI 38% to 48%). BJJ athletes reported most injuries (69.5%, 266/383), followed by Judo (14.6%, 56/383) and MMA grappling (7.6%, 29/383).

This study established that the majority of injuries occurred during training. This is consistent with the only other available injury surveillance study in British grappling, where a sample of 146 freestyle wrestlers based in Britain showed 79,1% of all reported injuries happened in training. This may be due to the heterogeneous training environments seen in many grappling clubs. Unlike professional football teams, grappling athletes have various skill levels, body types, and physical attributes, yet they commonly drill and spar together. This has been proposed as an injury risk factor in previous research[10,11]. Educating coaches on the importance of pairing grapplers of similar size and skill levels may help reduce training IR rates.

The previously mentioned freestyle wrestling study shows a higher competition IR of 42.01/1000 AE (95% CI 26.97 to 57.05) in British wrestlers compared to the grapplers in this current study, but reports a similar training IR of 2.92/1000h (95% CI 2.69 to 3.14)11. To the author's knowledge, no other study has reported IR using a mixed discipline sample with grappling disciplines such as BJJ, Catch wrestling, Sambo, and MMA grappling, which have no published training IR, making comparisons unachievable. However, a systematic review by Bromley et al. (2018)[34] found three Judo studies reported a value for training IR ranging from 1.48 to 12.8/1000h . Unfortunately, no competition values were stated for comparison. However, Mooren et al. (2023)[10] conducted a systematic review of collated injuries from 361,581 athletes sustained at 25 Judo tournaments and estimated competition IRs to range between 4.2 to 115/1000 AE, suggesting that IRs in Judo are generally higher in competition than in practice. This trend is likely due to the increased intensity seen in the competition and the duration of tournaments that often require grapplers to warm up and cool down multiple times throughout the day, requiring the athlete to prepare and recover from bouts over several hours, both mentally and physically.

The present study was the first to obtain injury prevalence data on multi-disciplinary grappling athletes from a UK cohort. However, prevalence rates are available for other samples across the world such as Hinz et al. (2021)[15] epidemiology study of BJJ athletes. The study has similarities to the current studies' methods as it adopted a retrospective self-reported study design. However, Hinz et al. (2021)[15] used social media platforms for participant recruitment and asked respondents to recall injuries from the previous 3 years, compared with the previous 12-month period deployed by the

present study. The study had 1140 respondents who reported that the knee region was injured most often (27.1%). The knee is also reported to be the most commonly injured site in several medically reported BJJ studies, with prevalence ranging from between 20.8 to 81.1%[13,14,16-18,20,35]. Brazilian Jiu-Jitsu (BJJ) studies are likely the most comparable to the current study, as BJJ athletes reported the most injuries (69.5%) across the cohort.

Judo athletes accounted for 14.6% of injuries within this study, with the knee being the primary body region (19.6%). This aligns with a 2021 medically reported study comprised of 26,862 Judokas competing in 128 international tournaments[36]. The study reported the knee (17.4%) as the most frequently injured body region. This also matches a previous medically reported study that used a mixed sample of Judoka and Sambo athletes, which showed the knee to be the most common site of injury (38,3%)[37]. This is also in agreement with the Sambo sample from the current study, which showed a 67% prevalence rate for the knee region. However, it must be noted that the small sample size achieved in Sambo athletes may reduce confidence in this finding.

The leading injury diagnosis found in the current study was ligament sprains (24.3%). This was consistent with self-reported findings from the De Almeida & de Araújo (2020)[38] BJJ study, where ligament sprains accounted for 22.1% of all injuries in a sample of 374 BJJ practitioners who competed in a Brazilian regional championships. This is also consistent with medically reported BJJ studies where ligament sprains are the most common diagnosis for BJJ injuries, with a reported relevance range of 22.1% to 64.2% of all injuries[14,38,39]. A recent review by Bell et al. (2024)[8] linked the data from biomechanical studies analysing wrestling takedowns and research into the mechanics of knee ligament injuries. It was proposed that grappling takedowns and most noticeable leg attacks involve knee torsion, lateral knee displacement, forced hyperextension and excessive force transmitted in the joint in the execution phase[40-42]. These variables have been strongly linked to knee ligament injuries[43-45]. Collectively, the results show a uniformity between external research and the different grappling disciplines within this study. This may allow for the development of injury prevention programmes that focus on the knee or the modification of existing programmes such as FIFA 11+.

The current study found the leading MOI to be 'an opponent attempting a submission' (19.8%). This aligns with Hinz et al. (2021)[15] retrospective BJJ injury study that reported 29.7% of injuries came from an opponent attempting a submission. However, other medically reported studies in BJJ have reported takedowns as the leading MOI (18.5%)[38]. This study's method matches Hinz et al. (2021) concerning splitting the options for takedowns into two, with being taken down by the opponent and 'taking an opponent down' as separate options. Many other grappling studies have reported this as a single option: takedowns[11,26,46]. If the data from this study's two categories were merged, takedown would have been the leading MOI 30.8 (118/383). However, this is still lower than the range of 39% to 54.3% reported in freestyle wrestling8and the range reported in Mooren et al. (2023)[10] Judo study (50 to 85.2%).

It was found that 43.1% (165/383) of all reported injuries were first occurrences, suggesting a higher recurrence rate (56.9%) than previous studies, which ranged from 14%-28.2% of injuries[47-49]. The majority of injuries were classified as "major" (49.5%, 184/372) in terms of severity. This is high in comparison to other UK samples in freestyle wrestlers (19.49%)[11] and American football (31.1%)[50]. Unlike the aforementioned freestyle wrestling study (14%, 17/121), the current study found a higher percentage of fractures (18.9%, 42/226). Additionally, the ligament injuries to the knee, the most common body location and diagnosis, have been reported to result in the highest rate of severe injuries in several sports, such as soccer, American football, basketball, and grappling disciplines, such as Judo[10,50,51]. Factors such as these may help explain the high rates of major injuries and emphasise the need for injury prevention programmes that strengthen the non-contractile surrounding the knee. A consideration that may have affected the reporting of severity rates is the high percentage of respondents who continue training, to some extent, while injured (62.4%, 239/383). However, this may have lowered the reported injury severity periods, with athletes returning before injuries were resolved. Grapplers may continue to train when injured as they rely on the sport to manage mental health and wellbeing, with several recent studies showing that regular BJJ practice has been shown to help with anxiety, depression, reduce alcohol intake and improve physical health[52,53].

CLINICAL IMPLICATIONS

The clinical implications of this study's findings are significant for healthcare providers, coaches, and grappling athletes. The high prevalence of knee injuries, particularly ligament sprains, across all grappling disciplines highlights the need for developing lower limb injury prevention programs. Our study found that most injuries occurred during training. It is plausible to suggest that this may be due to a lack of supervision and structure. Furthermore, coaches and athletes could consider partnering with grapplers of a similar weight category and experience level to lower the risk of injury. Additionally, it would be beneficial to introduce educational courses for grappling coaches, enabling them to learn about common injuries and associated risk factors.

This study highlights the knee as the most frequently injured body region. Although previous injury prevention warm-ups for grappling have been published8, none have been through a robust scientific evaluation. The logical next step would be to design and evaluate such a programme using best practices from other sports with established injury prevention programmes54. This could use techniques from pre-existing, scientifically validated programmes that have been shown to reduce knee injuries, such as FIFA 11+[55].

Some further modifications to the injury prevention warm-ups could be the inclusion of breakfalls. Breakfall techniques, referred to as Ukemi in Judo, are vital for reducing head injury risks in injury prevention programmes[56]. Research shows that peak resultant translational acceleration (PRTA) and coronal rotation prevent injuries to the head and neck[56-58]. The backwards breakfall (Ushiro Ukemi) has been shown to dissipate impact forces and reduce vertical velocity, making it essential for grappling sports (Hashimoto et al., 2015)[59]. Lockhart et al.'s (2022)[60] Systematic Review of the link between the biomechanics of breakfall technique and Injury in Judo concluded that training breakfalls and dynamic strength reduces the risk of upper and lower body injury in Judokas.

The one-on-one nature of these sports, coupled with weight-class and skill-level matching, might reduce injury rates compared to other contact sports; however, this is not always the case in a training environment. The aim of grappling sports, like most combat sports, is to submit or gain physical control over your opponent with techniques that are inherently designed to cause harm. Therefore, it is suggested that a greater level of coach education and supervision is needed, as well as the use of multiple coaches for larger group sizes. Limiting specific grappling techniques and submissions within the training environment to certain belt colours and experience levels, as seen in some competitions[61] may also aid in injury reduction. Finally, the limited data for certain grappling disciplines, such as Sambo and Greco-Roman wrestling, calls for further investigation to provide a more comprehensive understanding of injury patterns and management strategies across these sports.

LIMITATIONS

The study employed a self-reported and retrospective methodology, as this was the only feasible approach given the absence of consistent medical provisions support in grappling disciplines. This is due to the sport's amateur nature, where most grapplers are hobbyists. If enhanced medical support across grappling disciplines improves, it may enable a prospective, medically reported method to be compiled. This would offer more accurate estimates of diagnoses, injury incidence, and prevalence rates.

Low sample sizes were seen for Catch wrestling, MMA grappling, Sambo, and Greco-Roman wrestling, which was largely due to their popularity within the UK. This created unbalanced samples and reduced the opportunity to complete further analysis across disciplines.

CONCLUSION

This study provides valuable insights into the injury patterns among grappling athletes in the UK. The overall injury rate in grappling disciplines aligns with other contact sports, though the injury incidence during competition remains lower than in many team sports. Notably, the knee emerged as the most frequently injured body region, accounting for nearly 1 in 4 injuries, with ligament sprains being the most common diagnosis. This highlights the need for targeted prevention programs focusing on these vulnerabilities.

Injury mechanisms, such as submissions and takedowns, indicate specific areas where intervention strategies, including technique

refinement and supervised practice, could mitigate risks. The prevalence of injuries during training underlines the importance of structured training environments and comprehensive warm-up routines to reduce injury occurrences.

AUTHOR CONTRIBUTIONS

JB was the lead author and conceptualised the study. JB was responsible for data collection. JB, ET and AJ contributed to the design and proofreading of the manuscript.

CONFLICTS OF INTEREST

JB is the head of Sports Medicine for the English MMA Association. This work is in no way influenced by this association.

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ETHICAL APPROVAL

The School of Health Ethics Committee approved the study at Leeds Beckett University (ethics number 135704).

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