Injuries among Brazilian male Jiu-Jitsu athletes

Giovanna Medina*[1], MD, PhD
Email: gismedina7@gmail.com
https://orcid.org/0000-0002-2266-9640

Breno Schor[1], MD, PhD
Email: breno@vita.org.br
https://orcid.org/0000-0002-6870-2936

Caio Oliveira D'Elia[1], MD, PhD
Email: caio@vita.org.br
https://orcid.org/0000-0002-4446-5219

Antonio Guilherme Padovani Garofo[1], MD
Email: guilherme.garofo@vita.org.br
https://orcid.org/0000-0002-1598-1222

Alexandre Carneiro Bitar[1], MD, MSc
Email: bitar@vita.org.br
https://orcid.org/0000-0002-5156-8144

Juliana Mauad[1], MD
Email: juliana.ribeiromauad@gmail.com
https://orcid.org/0000-0002-8785-1670

Wagner Castropil[1], MD, PhD
Email: castropil@vita.org.br
https://orcid.org/0000-0001-8762-450X

[1]Instituto Vita, São Paulo, Brazil

The study was performed at Instituto Vita, São Paulo, Brazil

ABSTRACT

The purpose of this study was to describe the injuries related to the practice and competition of Jiu-Jitsu (JJ) in Brazil. Athletes answered a survey regarding previous injuries sustained during training or competition that resulted in missing practice or competition for at least one week. One hundred and fifteen male athletes were included (mean age 30.2). A total of 415 injuries were recorded. The number of injuries sustained by each athlete ranged from 0-12 (mean of 3.6). Knee was the most affected site (18.8%), followed by the shoulder girdle (15.9%), ankle (12.3%), and hand (11%). Sprain was the most common diagnosis (31.3%). Traumatic causes were responsible for approximately 70% of the injuries. Results indicated a positive correlation between number of injuries and years JJ practice ($p < 0.001$), age ($p < 0.01$), belt graduation ($p < 0.001$) and level of competition ($p < 0.001$). In conclusion, most injuries are acute traumatic musculoskeletal injuries to the knee and shoulder, and both time exposure and intensity of JJ practice are risk factors.

Keywords: Martial arts, Epidemiology, General Sports Trauma, Sports.

INTRODUCTION

Jiu-jitsu (JJ) became popular in the early 19th century, and is a martial art developed to allow the samurai to survive in case of losing their weapons. The basic moves involve torsion, lever movements, throws and submission holdings to take the opponent down ultimately. Despite seeming brutal, the principle of this fight is to use the opponent's force against himself so that a thin, small monk could defeat any opponent (del Vecchio et al., 2016).

Acute trauma or repetitive stress is common in JJ practice, as is a grappling-based martial art. However, these injuries present different prevalence among novice and experienced athletes (Moriarty et al., 2019; Silva Júnior et al., 2018). Thus, specific prevention strategies first require characterizing injured participants.

Studies including athletes from different martial arts may mislead the location and the trauma mechanism of the injuries of a specific sport (Birrer & Birrer, 1982; Jensen et al., 2017). In general, striking-predominant disciplines have high head and facial injury rates, whereas submission-predominant sports, including JJ, have high joint injury rates (das Graças et al., 2017; Jensen et al., 2017).

Despite the growing popularity of JJ worldwide, injuries prevenient from this martial art are still scarce in the literature. Most studies regarding injuries in JJ athletes were performed during competitions, and only acute injuries were reported (Kreiswirth et al., 2014; Scoggin et al., 2014). To our knowledge, this is the first study to include practice sessions and chronic injuries associated with this martial art. According to previous research (Kujala et al., 1995), injuries occurring during practice sessions account for approximately 70% of martial arts injuries, while 30% occur at competitions.

The main purpose of this study is to describe the injuries in JJ athletes, considering injuries associated with practice sessions and competitions.

METHODS

This study was evaluated and approved by the Institutional Review Board of the Institute Fleury; #16893819.7.0000.5474.

A cross-sectional study including JJ athletes of three big training centres. The athletes answered a survey, and the inclusion criteria were male athletes, willingness to participate in the study, and 16 years old or older. All participants signed the informed consent form.

Only one researcher interviewed the athletes from three big training centres. The questions were about injuries during training or JJ competition that resulted in missing practice for at least one week. The first part addressed demographic data such as age, gender, weight, high (body mass index (BMI) calculation), category, belt level, years of JJ practice, training hours per week, competitive level (non-competitive, state, national, and international). Category and belt levels were based on the International Federation of Brazilian Jiu Jitsu (IBJJF) guidelines (IBJJF IBJ-J, 2022). The second part explored the type and location of the injuries if any had occurred. The interviewer presented a list of body parts and possible diagnoses. For each injury location and time away longer than seven days, the athlete pointed out the type of injury he had sustained. This list was a modification of the International Olympic Committee (IOC) (Junge et al., 2008).

Statistical analysis

Quantitative variables were reported using the minimum and maximum values range, significance, standard deviation (SD) and 95% confidence interval (CI). Qualitative variables were

analysed through relative and absolute frequencies. Normality tests were performed to decide whether parametric or non-parametric tests would apply. The Kruskal-Wallis test was used to compare the belt and the competition level, and the Pearson correlation coefficient was used. The 5% significance level was established for this study, and all analyses were performed using the IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA).

RESULTS

A total of 115 male athletes were included (Table 1). More than 75% of the athletes were light, middle, medium heavy or heavy weight (Figure 1). Approximately 38% had brown or black belt graduation (Figure 2). Distribution of the competition level: twenty-seven athletes (23.5%) trained but did not compete regularly, 14 athletes (12.2%) participated in state tournaments, 32 (27.8%) in national, and 42 (36.5%) in international competitions.

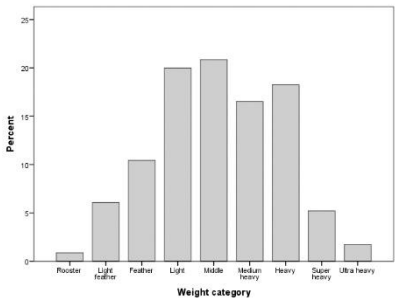

Figure 1 – Frequency distribution of the percentage of athletes in each weight category

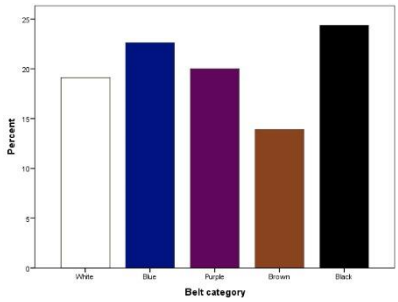

Figure 2 – Frequency distribution of the total number and percentage of athletes by belt level

One hundred and two athletes (88%) reported at least one injury, and 13 athletes (12%) said they had never had an injury related to this sport. The number of injuries sustained by each athlete ranged from 0–12 (mean = 3.61; SD = 2.99; 95% CI = 3.06–4.16), and more than half (61.7%) had three injuries in total (Figure 3).

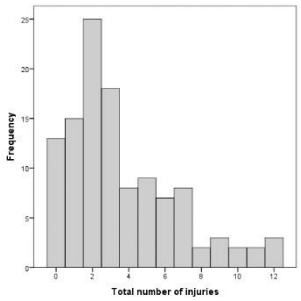

Figure 3 – Distribution of the total number of injuries per absolute number of athletes that reported the injuries

A total of 415 injuries occurred in 102 athletes. Knee was the most affected site (18.8%), followed by the shoulder girdle (15.9%), ankle (12.3%), and hand (11%). These four regions accounted for more than half of the injuries reported (Figure 4 and Table 3). Sprain was the most common diagnosis, corresponding to 31.3% of all cases, followed by

contusion/hematomas/bruises (15.7%), fracture (9.9%), and dislocation/subluxation (9.9%). Traumatic causes were responsible for approximately 70% of the injuries (Table 3).

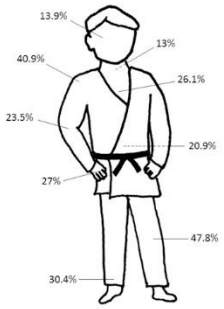

Figure 4 – Schematic representation of the incidence of injury per anatomical site in the athletes analysed in this study. The image shows only anatomical sites with incidences higher than 10%

Pearson correlation test was used to examine the correlation between the number of injuries reported by an athlete and the years practising JJ, hours of JJ training per week, age, and JJ belt graduation. Results indicated a positive correlation between number of injuries and years JJ practice (r (115) = + 0.468, $p < 0.001$, two-tailed; Figure 5A) and age (r (115) = + 0.227, $p < 0.01$, two-tailed; Figure 5B). However, there was no correlation between the number of injuries and hours of JJ training per week ($p = 0.93$) and BMI ($p = 0.71$).

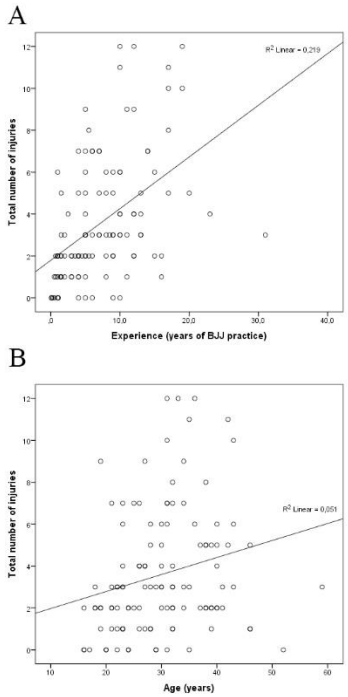

Figure 5 – Correlation between number of injuries and (A) number of years practicing JJ and (B) between number of injuries and age

Non-parametric Kruskall-Wallis test demonstrated a significant difference between belt graduation and the number of injuries ($p < 0.001$; Table 4). Competitors at international level had significantly more injuries than non-competitors ($p < 0.05$; Table 5).

DISCUSSION

Every specific modality carries specific most common injury locations, for example, Kendo: foot/ankle, wrist/hand, and elbow/forearm (Schultzel et al., 2016), mixed martial arts (MMA): head injuries (Fares et al., 2019; Thomas & Thomas, 2018), Taekwondo: lower extremities in defence movements (Thomas et al., 2017), Muay Thai: lowers and upper extremities (Strotmeyer

et al., 2016), Wrestling: head/neck (during competitions) (Thomas & Zamanpour, 2018), Judo: knee, shoulder, and fingers (Pocecco et al., 2013), Karate: head and neck (Thomas & Ornstein, 2018).

McDonald et al. (2017) study reported the injuries sustained during JJ training in 140 athletes in the USA. Among 140 athletes, 120 (85.7%) had at least one injury, and 487 injuries were documented (mean of 4.06 injuries per athlete) (McDonald et al., 2017). In contrast to our study, the authors broke down the injuries in medically- and self-diagnosed injuries. In decrescent order, the most common self-diagnosed reported injuries were hand/fingers, foot/toes, arm/elbow and knee. Interestingly, the most common medically diagnosed conditions were skin infections. In addition, they have found that upper extremity injuries are more frequent but less severe than the lower extremities.

In our study, acute injuries were classified as muscle cramps, contusion/hematoma/bruises, fractures, dislocation/ subluxation, tendon rupture, and ligament injury. In frequency order, the first four injuries were the most common. Chronic injury rate can be considered relatively low in advanced athletes, being more prevalent in novice (del Vecchio et al., 2016; Silva Júnior et al., 2018). The injuries include cartilage damage, tendonitis, nerve compression, bursitis, stress fractures, and others (herniated disc, shoulder and femoroacetabular impingement syndrome).

The upper and lower extremities (knee and shoulder) are the main sites of injuries. In general, the findings for acute and chronic injuries are similar to Scoggin et al. (2014), das Graças et al. (2017), Silva Júnior et al. (2018), and Moriarty et al. (2019) findings.

The number of injuries reported in the literature should be interpreted accordingly to the method of data collection: self-diagnosed vs medical diagnosed, retrospective vs cross-sectional (defined interval), and other variables such as gender, age, and expertise. In our study, for example, the athletes had a mean of 3.6 injuries in contrast to 1.27 found by das Graças et al. (2017), while

the mean 88 months (7.36 years) of JJ practice vs 37 months (3.08 years). In addition, the athletes that report at least one injury during their carrier is close to 90% in different studies (including ours) (McDonald et al., 2017; Petrisor et al., 2019). The incidence rate was close to 60% in six months of practice (Moriarty et al., 2019).

During the competition, the incidence of injuries seems to be higher, as reported by our and other studies (Petrisor et al., 2019; Silva Júnior et al., 2018). Other authors also reported that the amount of training and more experienced competitors are predictive risk factors for the number of injuries (das Graças et al., 2017; Kreiswirth et al., 2014; Reis et al., 2015; Vitale et al., 2018). Additionally, another risk factor associated with a higher risk of injury was muscular imbalance and movement dysfunction (del Vecchio et al., 2016), which is known to affect most JJ athletes because of sport gesture, and the lack of flexibility found in these athletes (Andreato et al., 2016; del Vecchio et al., 2016).

Our study has some limitations, including recall bias, since the athletes had to remember the previous injuries related to JJ practice and competition, which becomes complex for experienced athletes with years of training. Another aspect to consider is that all diagnoses were based on the information the athlete received at the time of injury. Also, because the injuries were reported retrospectively, there were no data to calculate the injury rate (number of injuries related to the number of times the athletes were exposed), as in other studies. Similar to published studies, our study reports the injuries only in male JJ athletes (Andreato et al., 2016). Future studies, including the female population, are needed.

Observational studies are considered the first step to identifying injury patterns for a particular sport, measuring the problem's extent, establishing the risk factors involved, and preventing future injuries. Understanding the combat style context (Báez et al., 2014; del Vecchio

et al., 2016; Lima et al., 2017), anthropometric characteristics (Báez et al., 2014; Vitale et al., 2018), injury mechanism (Bahr & Krosshaug, 2005; de Almeida et al., 2017), and performing the athletes' individualised and general evaluation (del Vecchio et al., 2016) may help the prevention and treatment of injuries related to JJ.

CONCLUSION

A high incidence of self-diagnosed injuries was found in a group of JJ athletes in three training centres with a long practice period. Most injuries occurred respectively in the knee and shoulder. The more experienced the athlete, the higher the risk for injuries, not only about the higher belt level (graduation) but also the competition level. Both time exposure and intensity of JJ practice are risk factors.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHORSHIP

All authors contributed with the following activities in this work: Substantial contributions to the conception or design of the work, or the acquisition, analysis or interpretation of data; Drafting the work or revising it critically for important intellectual content; Final approval of the version published; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

FUNDING

The authors reported there is no funding associated with the work featured in this article.

REFERENCES

Andreato, L. v., Santos, J. F., Esteves, J. V., Panissa, V. L., Julio, U. F., & Franchini, E. (2016). Physiological, Nutritional and Performance Profiles of Brazilian Jiu-Jitsu Athletes. *Journal of Human Kinetics*, *53*(1), 261–271. https://doi.org/10.1515/HUKIN-2016-0029

Báez, E., Franchini, E., Ramírez-Campillo, R., Cañas-Jamett, R., Herrera, T., Burgos-Jara, C., & Henríquez-Olguín, C. (2014). Anthropometric Characteristics of Top-Class Brazilian Jiu Jitsu Athletes: Role of Fighting Style. *International Journal of Morphology*, *32*(3), 1043–1050. https://doi.org/10.4067/S0717-95022014000300048

Bahr, R., & Krosshaug, T. (2005). Understanding injury mechanisms: a key component of preventing injuries in sport. *British Journal of Sports Medicine*, *39*(6), 324–329. https://doi.org/10.1136/BJSM.2005.018341

Birrer, R. B., & Birrer, C. D. (1982). Martial Arts Injuries. *The Physician and Sportsmedicine*, *10*(6), 103–108. https://doi.org/10.1080/00913847.1982.11947249

das Graças, D., Nakamura, L., Barbosa, F. S. S., Martinez, P. F., Reis, F. A., & de Oliveira-Junior, S. A. (2017). Could current factors be associated with retrospective sports injuries in Brazilian jiu-jitsu? A cross-sectional study. *BMC Sports Science, Medicine & Rehabilitation*, *9*(1). https://doi.org/10.1186/S13102-017-0080-2

de Almeida, T. B. C., Dobashi, E. T., Nishimi, A. Y., de Almeida, E. B., Pascarelli, L., & Rodrigues, L. M. R. (2017). Analysis of the pattern and mechanism of elbow injuries related to

armbar-type armlocks in jiu-jitsu fighters. *Acta Ortopedica Brasileira*, *25*(5), 209–211. https://doi.org/10.1590/1413-785220172505171198

del Vecchio, F. B., Gondim, D. F., & Arruda, A. C. P. (2016). Functional Movement Screening Performance of Brazilian Jiu-Jitsu Athletes From Brazil: Differences Considering Practice Time and Combat Style. *Journal of Strength and Conditioning Research*, *30*(8), 2341–2347. https://doi.org/10.1519/JSC.0000000000001324

Fares, M. Y., Fares, J., Fares, Y., & Abboud, J. A. (2019). Musculoskeletal and head injuries in the Ultimate Fighting Championship (UFC). *The Physician and Sportsmedicine*, *47*(2), 205–211. https://doi.org/10.1080/00913847.2018.1546108

IBJJF IBJ-J. (2022). *General system of graduation* .

Jensen, A. R., Maciel, R. C., Petrigliano, F. A., Rodriguez, J. P., & Brooks, A. G. (2017). Injuries Sustained by the Mixed Martial Arts Athlete. *Sports Health*, *9*(1), 64–69. https://doi.org/10.1177/1941738116664860

Junge, A., Engebretsen, L., Alonso, J. M., Renström, P., Mountjoy, M., Aubry, M., & Dvorak, J. (2008). Injury surveillance in multi-sport events: the International Olympic Committee approach. *British Journal of Sports Medicine*, *42*(6), 413–421. https://doi.org/10.1136/BJSM.2008.046631

Kreiswirth, E. M., Myer, G. D., & Rauh, M. J. (2014). Incidence of injury among male Brazilian jiujitsu fighters at the World Jiu-Jitsu No-Gi Championship 2009. *Journal of Athletic Training*, *49*(1), 89–94. https://doi.org/10.4085/1062-6050-49.1.11

Kujala, U. M., Taimela, S., Antti-Poika, I., Orava, S., Tuominen, R., & Myllynen, P. (1995). Acute injuries in soccer, ice hockey, volleyball, basketball, judo, and karate: analysis of national registry data. *BMJ (Clinical Research Ed.)*, *311*(7018), 1465. https://doi.org/10.1136/BMJ.311.7018.1465

Lima, P. O. de P., Lima, A. A., Coelho, A. C. S., Lima, Y. L., Almeida, G. P. L., Bezerra, M. A., & de Oliveira, R. R. (2017). BIOMECHANICAL DIFFERENCES IN BRAZILIAN JIU-JITSU ATHLETES: THE ROLE OF COMBAT STYLE. *International Journal of Sports Physical Therapy*, *12*(1), 67–74.

McDonald, A. R., Murdock, F. A., McDonald, J. A., & Wolf, C. J. (2017). Prevalence of Injuries during Brazilian Jiu-Jitsu Training. *Sports (Basel, Switzerland)*, *5*(2). https://doi.org/10.3390/SPORTS5020039

Moriarty, C., Charnoff, J., & Felix, E. R. (2019). Injury rate and pattern among Brazilian jiu-jitsu practitioners: A survey study. *Physical Therapy in Sport : Official Journal of the Association of Chartered Physiotherapists in Sports Medicine*, *39*, 107–113. https://doi.org/10.1016/J.PTSP.2019.06.012

Petrisor, B. A., del Fabbro, G., Madden, K., Khan, M., Joslin, J., & Bhandari, M. (2019). Injury in Brazilian Jiu-Jitsu Training. *Sports Health*, *11*(5), 432–439. https://doi.org/10.1177/1941738119849112

Pocecco, E., Ruedl, G., Stankovic, N., Sterkowicz, S., del Vecchio, F. B., Gutiérrez-García, C., Rousseau, R., Wolf, M., Kopp, M., Miarka, B., Menz, V., Krüsmann, P., Calmet, M., Malliaropoulos, N., & Burtscher, M. (2013). Injuries in judo: a systematic literature review including suggestions for prevention. *British Journal of Sports Medicine*, *47*(18), 1139–1143. https://doi.org/10.1136/BJSPORTS-2013-092886

Reis, F. J. J., Dias, M. D., Newlands, F., Meziat-Filho, N., & Macedo, A. R. (2015). Chronic low back pain and disability in Brazilian jiu-jitsu athletes. *Physical Therapy in Sport : Official Journal*

of the Association of Chartered Physiotherapists in Sports Medicine, *16*(4), 340–343. https://doi.org/10.1016/J.PTSP.2015.02.005

Schultzel, M., Schultzel, M., Wentz, B., & Bernhardt, M. (2016). The prevalence of injury in Kendo. *The Physician and Sportsmedicine*, *44*(1), 29–33. https://doi.org/10.1080/00913847.2016.1105093

Scoggin, J. F., Brusovanik, G., Izuka, B. H., van Rilland, E. Z., Geling, O., & Tokumura, S. (2014). Assessment of Injuries During Brazilian Jiu-Jitsu Competition. *Orthopaedic Journal of Sports Medicine*, *2*(2). https://doi.org/10.1177/2325967114522184

Silva Júnior, J. N. da, Kons, R. L., Dellagrana, R. A., & Detanico, D. (2018). Injury prevalence in Brazilian jiu-jitsu athletes: comparison between different competitive levels. *Brazilian Journal of Kinanthropometry and Human Performance*, *20*(3), 280–289. https://doi.org/10.5007/1980-0037.2018v20n3p280

Strotmeyer, S., Coben, J. H., Fabio, A., Songer, T., & Brooks, M. (2016). Epidemiology of Muay Thai fight-related injuries. *Injury Epidemiology*, *3*(1). https://doi.org/10.1186/S40621-016-0095-2

Thomas, R. E., & Ornstein, J. (2018). Injuries in karate: systematic review. *The Physician and Sportsmedicine*, *46*(3), 279–303. https://doi.org/10.1080/00913847.2018.1472510

Thomas, R. E., & Thomas, B. C. (2018). Systematic review of injuries in mixed martial arts. *The Physician and Sportsmedicine*, *46*(2), 155–167. https://doi.org/10.1080/00913847.2018.1430451

Thomas, R. E., Thomas, B. C., & Vaska, M. M. (2017). Injuries in taekwando: systematic review. *The Physician and Sportsmedicine*, *45*(4), 372–390. https://doi.org/10.1080/00913847.2017.1369193

Thomas, R. E., & Zamanpour, K. (2018). lnjuries in wrestling: systematic review. *The Physician and Sportsmedicine*, *46*(2), 168–196. https://doi.org/10.1080/00913847.2018.1445406

Vitale, J. A., Bassani, T., Galbusera, F., Bianchi, A., & Martinelli, N. (2018). Injury rates in martial arts athletes and predictive risk factors for lower limb injuries. *The Journal of Sports Medicine and Physical Fitness*, *58*(9), 1296–1303. https://doi.org/10.23736/S0022-4707.17.07536-3

TABLES

Table 1 – Descriptive values for height, weight, and body mass index

Variable	n	Mean	SD	95% CI	Min	Max
Age (yrs)	115	30.2	8.35	28.6–31.7	16	59
Height (cm)	115	176.7	6.6	175.5–177.9	161	197
Weight (Kg)	115	82.6	13.7	80.05–85.12	50	154
BMI (kg/m2)	115	26.4	3.7	25.7–27.1	18.3	50.3
Years of practice	115	7.4	5.7	6.3–8.4	0.1	31
Hours of practice per week	115	10.5	6.8	9.3–11.8	3	40

N: number of participants; SD: standard deviation; CI: confidence interval; Min: minimum; Max: maximum; BMI: body mass index.

Table 2 – Relative and absolute frequencies of injuries according to anatomical site

Site of injury	Number of athletes injured	Incidence (%)	Number of injuries	% of total number of injuries
Knee	55	47.8	78	18.8
Shoulder/clavicle	47	40.9	66	15.9
Ankle	35	30.4	51	12.3
Hand	31	27.0	46	11.0
Sternum/Ribs	30	26.1	36	8.7
Elbow	27	23.5	35	8.4
Lumbar spine/ lower back	24	20.9	27	6.5
Face	16	13.9	17	4.1
Neck/cervical spine	15	13.0	15	3.6
Wrist	8	7.0	10	2.4
Hip	8	7.0	9	2.2
Lower leg	6	5.2	6	1.4
Pelvis/sacrum/buttock	4	3.5	5	1.2
Thigh	4	3.5	4	1.0
Thoracic spine/ upper back	3	2.6	3	0.7
Finger	3	2.6	3	0.7
Upper arm	2	1.7	2	0.5
Foot/toe	2	1.7	2	0.5
Total	-	-	415	100

Table 3 – Relative and absolute frequencies of the total injuries diagnosed

Diagnosis	Number of athletes injured	Incidence (%)	Number of injuries	% of total number of injuries
Sprain	66	57.4	130	31.3
Contusion/haematoma/bruise	50	43.5	65	15.7
Fracture	27	23.5	41	9.9
Dislocation/subluxation	24	20.9	41	9.9
Others	24	20.9	29	7.0
Injuries of meniscus or cartilage	17	14.8	23	5.5
Strain/muscle rupture/tear	15	13.0	17	4.1
Tendonosis/tendinopathy	12	10.4	17	4.1
Nerve injury/spinal cord	10	8.7	11	2.7
Bursitis	3	2.6	6	1.4
Tendon rupture	3	2.6	3	0.7
Ligamentous rupture with instability	2	1.7	2	0.5
Ligamentous rupture without instability	2	1.7	2	0.5
Muscle cramps or spasm	2	1.7	2	0.5
Other bone injuries	1	0.9	1	0.2
Not reported	12	10.4	25	6.0
Total	-	-	415	100

Table 4 – Descriptive values for injuries according to the belt level

Belt level	N	n	Mean	SD	95% CI	Min	Max	*p**
White [(c) (d) (e)]	22	34	1.54	2.07	2.12–3.41	0	6	
Blue [(c) (d) (e)]	26	68	2.61	2.18	3.49–4.53	0	7	< 0.001
Purple [(a) (b) (e)]	23	87	3.78	2.45	4.73–5.76	0	9	
Brown [(a) (b) (e)]	16	77	4.81	3.18	5.81–7.25	1	11	
Black [(a) (b)(c)(d)]	28	149	5.32	3.48	7.13–8.25	0	12	
Total	115	415						

N: number of athletes; n: number of injuries; SD: standard deviation; CI: confidence interval; (*) non-parametric test - Kruskal-Wallis; [(a)] significant difference comparing to white belt ($p < 0.05$); [(b)] significant difference comparing to blue belt ($p < 0.05$); [(c)] significant difference comparing to purple belt ($p < 0.05$); [(d)] significant difference comparing to brown belt ($p < 0.05$); [(e)] significant difference comparing to black belt ($p < 0.05$)

Table 5 – Descriptive and comparative values for number of injuries according to the competition level

Level of competition	**N**	**n**	**Mean**	**SD**	**95% CI**	**Min**	**Max**	***p****
Non-competitive [(b) (c)]	27	56	2.04	2.08	1.21–2.86	0	7	
State [(c)]	14	40	2.86	2.07	1.66–4.05	0	8	< 0.001
National [(c)]	32	96	3.03	2.36	2.18–3.88	0	12	
International	42	223	5.31	3.39	4.25–6.37	0	12	
Total	115	415						

N: number of athletes; n: number of injuries; SD: standard deviation; CI: confidence interval; (*) non-parametric test - Kruskal-Wallis; [(a)] significant difference comparing to state level ($p < 0.05$); [(b)] significant difference comparing to national level ($p < 0.05$); [(c)] significant difference comparing to international level ($p < 0.05$).