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## RESEARCH ARTICLE

### Prevalence and Profile of Musculoskeletal Injuries in High-Performance Professional Brazilian Jiu-Jitsu Athletes

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#### Abstract:

##### Background:

Brazilian Jiu-jitsu (BJJ) has become popular over the past years; however, few studies investigated the prevalence of injuries in this martial art modality.

##### Objective:

This study aimed to determine the prevalence of musculoskeletal injuries in BJJ competitors, along with their profile and characteristics.

##### Methods:

One hundred fifteen athletes were included in this cross-sectional study. A hundred fifteen professional high-performance athletes were selected from twenty-five BJJ gyms in São Paulo, Brazil. Descriptive analyses were used to demonstrate the athlete's characteristics. The Kruskal-Wallis non-parametric test was used to assess the significant differences between the number of injuries categorized by athlete's belt or performance level category. Additionally, Fisher's exact test was used to assess possible differences between the belts' frequency of total injuries and injuries per affected site.

##### Results:

We observed an injury prevalence of 85.2%, in which the knee (32.6%), shoulder (11.2%), and elbow (8.4%) were the most affected regions. We did not find any significant differences between the number of injuries and belt classification ( $p=0.093$ ) or the frequency of total injuries per anatomical region among belt classification ( $p=0.121$ ). Most injuries occurred during training (74%), and the main reason for time loss from training activities was trauma (70%).

##### Conclusion:

There is a high prevalence of injuries among BJJ competitors, and the most affected site was the knee.

**Keywords:** Martial arts, Jujitsu, Sports injuries, Injury prevention, Grappling, Musculoskeletal injuries.

#### Article History

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## 1. INTRODUCTION

Jiu-jitsu is a martial art originally from Asia and expanded to several countries in South America during the First World

War. This technique was further adopted in Brazil and today is known as Brazilian Jiu-jitsu (BJJ) all over the world [1]. With the growing number of participants and popularity, this martial art has been used as an alternative to improving daily life, gaining fitness, and working out body and mind, as seen in other modalities such as judo, karate, and taekwondo [2].

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BJJ is a martial art that requires speed, coordination, balance, strength, and muscle resistance [3]. Amongst the most common techniques are: (1) takedowns, aimed to bring the opponent to the ground; (2) chokeholds, using mechanical asphyxiation by constricting the opponent's neck; and (3) joint locks and torsions, aimed at pushing the joints beyond their tolerable range of motion [3].

As in any other sport, prolonged training and the high demands of competitive BJJ often lead to musculoskeletal injuries [2, 4 - 7]. These injuries can result from intrinsic and extrinsic factors or a combination of both. Intrinsic factors are related to age, gender, physical and motor conditioning, nutrition, and psychological elements [8]. Extrinsic factors are related to the technical specificity of each modality, the equipment used in sports practice, the schedule of training, competition load, and weather [8].

Martial arts have been the subject of studies on musculoskeletal injuries. Researchers investigate the incidence and prevalence of sports injuries in each martial art style as with other competitive sports. These data are used to analyze players' traits and training patterns for those injuries [2, 4 - 7]. Nevertheless, in a unique modality such as BJJ, there is an eminent need to conduct a more detailed investigation since the main objective of the sport is to bring the opponent into submission by using potentially injurious techniques.

Although the high popularity of BJJ over the past years, no studies are looking to understand the participant's profile or identify the prevalence of musculoskeletal injuries in this modality. Data on the most common musculoskeletal injuries and the athlete's profile are needed for future injury prevention and treatment programs. Therefore, the present study aimed to verify the prevalence of musculoskeletal injuries in high-performance BJJ athletes and describe their profile and training characteristics.

## 2. MATERIALS AND METHODS

### 2.1. Design

This is a cross-sectional, epidemiologic study. This research design and report followed the recommendations of Improving Healthcare Decisions Task Force (ISPOR), the Ethical Standards in Sports and Exercise Science Research (2), and the Ethical Principles for Medical Research Involving Human Subjects (Declaration of Helsinki) of The World Medical Association (WMA).

Our university Research Ethics Committee approved the study procedures with protocol #224014. All candidates voluntarily and individually signed an informed consent form containing this research information, along with risks, benefits, and purposes, before being included in the study sample. All authors declare having no conflict of interest while working on this research. There was no involvement from patients or public members in the design, conduct, reporting, or dissemination plans of this research.

### 2.2. Participants

High-performance athletes were selected from twenty-five

BJJ gyms in the Brazilian state of São Paulo. The eligibility criteria were: (1) competitor in the adult category; (2) both genders; (3) purple, brown or black belt; (4) affiliated member of the Brazilian Confederation of Sporting Jiu Jitsu (CBJJ); (5) participation in at least one national competition and one international competition in the last 3 years; regularly participate in BJJ training for the last 3 months, at least 3 times per week. All participants had to speak and understand Portuguese to avoid bias in the communication process.

The purple, brown, and black belts were selected to allow the analysis of athletes with a long history of practice, knowledge, and dedication to the sport. BJJ uses a ranking system with five progressive belt colors to identify its martial art skill expertise (white, blue, purple, brown, and black). So, the last three represent the sport's most experienced practitioners, usually enrolled in national and international competitions.

The study's purpose, procedures, possible risks, and benefits were explained to the candidates during the interview when they received an informed consent form to agree and confirm participation in the study. Final data was stored on a password-secure, internet cloud-based website to avoid the risk of data loss or leaking.

### 2.3. Instruments and Procedures

The questionnaire used in this study was developed by the authors of this study and based on previous studies in martial arts [4 - 8]. It can be accessed as Supplemental Material. The questionnaire was divided into four categories: (1) participant profile, including questions about weight, gender, and age; (2) training profile, including questions about training history, competitions participation, jiu-jitsu-related injuries, use of protective gear in training sessions and type of training mat used; (3) injury profile, injuries in the last three years (site of injury, circumstances, mechanism, recurrence, medical diagnosis and treatment, and impact of an injury on current performance).

In the present study, "musculoskeletal injury" was defined as "any lesion resulting from jiu-jitsu training or competition which caused the athlete to miss at least one training session." As there is no standard injury definition for martial arts, we adapted from previous studies [9, 10].

To develop the questionnaire, we used the Orchard Sports Injury Classification System (OSICS) to divide the anatomical regions of the body into four main segments: Head/Neck, Upper Limb, Trunk, and Lower Limb. Each of these segments was subdivided as follows: Head/Neck - head, neck, face, and cervical spine; Upper Limb - shoulder/clavicle regions (entitled "shoulder"), arm, elbow, forearm, wrist, and hands/fingers; Trunk - thoracic spine/sternum/ribs (entitled "thoracic spine"), abdomen, lumbar spine/pelvis/pubis/sacrum (entitled "lumbar spine"); and finally Lower Limb -hip/groin, thigh, knee, leg/Achilles tendon, ankle, and feet/toes [11, 12].

### 2.4. Statistical Analysis

Descriptive analyses were used to demonstrate the athlete's individual characteristics. Before the statistical tests were

conducted, the assumptions of normality and homoscedasticity of variance were assessed using the Shapiro-Wilk test ( $\alpha = 0.05$ ) and the Bartlett test ( $\alpha = 0.05$ ), respectively.

The Kruskal-Wallis non-parametric test ( $\alpha = 0.05$ ) was used to assess the significant differences between the number of injuries per belt because the data did not present normal distribution. Fisher's exact test ( $\alpha = 0.05$ ) was used to assess possible differences between the belts' frequency of total injuries and injuries per affected site.

To reduce the chance of type I error (*i.e.*, to reject the null hypothesis that there is no difference between the frequencies of injuries when it is true), we used Bonferroni's correction, which divides the initial alpha value by the number of tests run. As 10 exact Fisher's tests were run, the initial alpha was corrected to 0.005. All statistical analyses were done using the R Statistical package version 2.14.1.

### 3. RESULTS

A total of 115 BJJ high-performance, competitive athletes of both genders, were included (105 males and 10 females). Regarding the level of the athletes, there were 47 purple belts, 26 brown belts, and 42 black belts. The average age was 25.8 ( $\pm 4.1$ ) years. The complete description of the participants is described in Table 1.

Regarding the presence of musculoskeletal injuries, 98 participants reported at least one injury, representing an injury prevalence of 85.2%. The three main anatomical regions reported were the knee (32.6%), shoulder (11.2%), and elbow (8.4%). We did not find any significant differences between the number of injuries and belt classification ( $p=0.093$ ) or the frequency of total injuries per anatomical region among belt

classification ( $p=0.121$ ). The training characteristics of the athletes are described in Table 2.

We noted that most injuries occurred during training (74.0%), and trauma was the main reason for time loss from training activities (70.2%). Regarding the time needed for recovery, athletes usually need more than four weeks to return to their normal activities. The full description of the musculoskeletal injuries according to injury characteristics is described in Table 3.

### 4. DISCUSSION

This study presented the prevalence of musculoskeletal injuries in high-performance BJJ athletes and described their profile and training characteristics. The main characteristics reported in this study (*i.e.*, age, weight, gender) were similar to other studies conducted on different types of martial arts [7, 13 - 17]. We found a prevalence of musculoskeletal injury of 85.2% in the included athletes. These findings are in agreement with studies on other martial arts, such as Karate (86.6%) [15], Wrestling (85.3%) [18], and Judo (85.3%) [19], but below the prevalence rate found in another BJJ study of 97.5% (Souza, 2009). This difference may be due to the different definitions of "musculoskeletal injury" used, as the term "musculoskeletal pain" was included in the musculoskeletal injury definition. Additionally, the smaller sample size ( $n=39$ ) may affect prevalence. This large number of injuries can be explained by the combination of intrinsic and extrinsic risk factors commonly related to sports injuries [20, 21]. However, to the best of our knowledge, there are no published studies which investigated risk factors of BJJ related musculoskeletal injuries.

**Table 1. Athlete's profile by ranking or belt, (mean  $\pm$  standard deviation).**

Variables		Total (n=115)	Athlete's Belt		
			Purple (n=47)	Brown (n=26)	Black (n=42)
Sex	Male	105 (91,3%)	41 (87,2%)	25 (96,2%)	39 (92,9%)
	Female	10 (8,7%)	6 (12,8%)	1 (3,8%)	3 (7,1%)
Mass (kg)	-	78,6 $\pm$ 11,7	77,2 $\pm$ 13,1	78,3 $\pm$ 10,3	80,3 $\pm$ 10,9
Age (Years)	-	25,8 $\pm$ 4,1	23,9 $\pm$ 4	25 $\pm$ 3,3	28,5 $\pm$ 3,4

**Table 2. Characteristics of Jiu-Jitsu training (mean  $\pm$  standard deviation).**

Variables		Total (n=115)	Athlete's Belt		
			Purple (n=47)	Brown (n=26)	Black (n=42)
Training History	Years of Training	9.8 $\pm$ 4.1	6.9 $\pm$ 2.6	10.1 $\pm$ 2.7	12.7 $\pm$ 3.9
	Weekly Frequency	5.5 $\pm$ 0.8	5.3 $\pm$ 0.8	5.5 $\pm$ 0.8	5.7 $\pm$ 0.7
	Training Hours/Week	18.5 $\pm$ 9.0	16.1 $\pm$ 7.7	19.2 $\pm$ 9.2	20.8 $\pm$ 9.7
Competition Profile	Number of Competitions per Year	1.2 $\pm$ 1.1	0.7 $\pm$ 0.4	1.2 $\pm$ 1.5	2.0 $\pm$ 1.5
	Number of Adversaries per Competition	5.2 $\pm$ 2.1	5.1 $\pm$ 2.1	5.4 $\pm$ 1.9	8.2 $\pm$ 2.4
JiuJitsu Related Injuries	Presence	98 (85,2%)	36 (76,6%)	24 (92,3%)	38 (90,5%)
	Quantity (#1)	29 (29,6%)	9 (25,0%)	7 (29,2%)	13 (34,2%)
	Quantity (#2)	21 (21,4%)	11 (30,6%)	3 (12,5%)	7 (18,4%)
	Quantity (#3+)	48 (49,0%)	16 (44,4%)	14 (58,3%)	18 (47,4%)
Training Mat Type Used	Rubber	71 (61,7%)	26 (55,3%)	20 (76,9%)	25 (59,5%)
	Canvas	44 (38,3%)	21(44,7%)	6(23,1%)	17 (40,5%)

(Table 2) contd.....

Variables		Total (n=115)	Athlete's Belt		
			Purple (n=47)	Brown (n=26)	Black (n=42)
Protective Gear	Regular Use	35 (30,4%)	13 (27,7%)	4 (15,4%)	18 (42,9%)
	One Gear	30 (85,7%)	10 (76,9%)	4 (100,0%)	16 (88,9%)
	Two Gears	4 (11,4%)	2 (15,4%)	0 (0,0%)	2 (11,1%)
	Three or more	1 (2,9%)	1 (7,7%)	0 (0,0%)	0 (0,0%)

Table 3. Musculoskeletal injuries profile according to its location, situation and mechanism, n(%).

-	Situations		Mechanism		Recovery Time Loss				Recurrence of Same Injury	Formally Diagnosed	Formally Treated	Performance Affected
	Training	Competition	Trauma	Overuse	≤1 week	1-2 weeks	3-4 weeks	>4 weeks	yes	yes	yes	yes
Knee (n=70)	42(60.0)	28(40)	49(70.0)	21(30.0)	11(15.7)	13(18.6)	15(21.4)	31(44.3)	23(32.9)	45(64.3)	61(87.1)	30(42.9)
Shoulder (n=28)	22(91.7)	2(8.3)	12(50.0)	12(50.0)	5(20.8)	7(29.2)	5(20.8)	7(29.2)	6(25.0)	13(54.2)	21(87.5)	10(41.7)
Elbow (n=18)	11(61.1)	7(38.9)	15(83.3)	3(16.7)	5(27.8)	7(38.9)	3(16.7)	3(16.7)	3(16.7)	8(44.4)	14(77.8)	4(22.2)
Thoracic spine (n=17)	18(88.2)	2(11.8)	13(76.5)	4(23.5)	2(11.8)	6(35.3)	7(41.1)	2(11.8)	4(23.5)	7(41.1)	11(64.7)	5(29.4)
Feet or toes (n=17)	12(70.6)	5(29.4)	16(94.1)	1(5.9)	3(17.6)	6(33.5)	2(11.8)	6(35.3)	2(11.8)	9(52.9)	10(58.8)	5(29.4)
Lumber spine (n=15)	14(93.3)	1(6.7)	6(40.0)	9(60.0)	5(33.3)	3(20.0)	4(26.7)	3(20.0)	3(20.0)	6(40.0)	12(80.0)	6(40.0)
Ankle (n=12)	9(75.0)	3(25.0)	11(91.7)	1(8.3)	2(16.7)	7(58.3)	2(16.7)	1(8.3)	4(33.3)	7(58.3)	10(83.3)	4(33.3)
Hand fingers (n=10)	8(80.0)	2(20.0)	9(90.0)	1(10.0)	2(20.0)	5(50.0)	1(10.0)	2(20.0)	2(20.0)	6(60.0)	8(80.0)	5(50.0)
Cervical Spine (n=9)	7(77.8)	2(22.2)	4(44.4)	5(55.6)	2(22.2)	3(33.3)	3(33.3)	1(11.2)	4(44.4)	3(33.3)	5(55.6)	2(22.2)
Others sites (n=23)	19(82.6)	4(17.4)	16(69.6)	7(30.4)	5(21.8)	7(30.4)	4(17.4)	7(30.4)	1(4.3)	15(65.2)	20(87.0)	4(17.4)
Total Injuries (n=215)	159(74.0)	56(26.0)	151(70.2)	64(29.8)	42(19.5)	64(29.8)	46(21.4)	63(29.3)	52(24.2)	119(55.3)	172(80.0)	75(34.9)

In this study, the knee was the most affected site, followed by the shoulder and elbow. These data corroborate a previous study comparing injuries in Karate and BJJ, where the most affected sites were the knee, shoulder, and ears [15]. The shoulder and knee regions were also prevalent injury sites in Judo and Wrestling athletes [14, 19, 22, 23]. It seems that injuries are directly linked with each modality's specific movements and technique. In BJJ and other martial arts, the predominant movements are joint locks and takedowns/falls aiming to immobilize the opponent, in which the most targeted sites are the knees and shoulders; this explains why there are more injuries in these regions. On the other hand, in sports that use punches and kicks (e.g., Karate) as the main movements, the most affected areas are the feet, hands, and face [15].

We observed that from the 215 injuries reported in this study, 159 (74.0%) occurred during training, and traumatic

injuries were more prevalent than non-traumatic or overuse injuries, similar to previous studies in martial arts, in which acute traumatic injuries are dominant as a result of the characteristics of the sport [8, 24]. We also found a recurrence injury rate of 24.2%, and 34.9% of the participants reported that their previous injuries still affected their performance. Previous injuries have been indicated as a risk factor in other sports [21] and need further investigation in martial arts modalities.

**5. STUDY LIMITATIONS**

This study has some limitations, and we suggest that our findings be interpreted cautiously. First, our study used a cross-sectional design, thus no causation should be concluded. We strongly suggest that more prospective, longitudinal studies should be performed in the future with a more balanced

proportion of males and females. Second, we collected all information from the respondents through a self-report questionnaire, with no clinical assessment being performed (and this is the main reason body height was not given by all participants, as weight alone classifies them on each competitive category). We understand that a clinical assessment by a professional would increase injury data's accuracy and reliability. Finally, our questionnaire did not extract technical information about the training sessions load and methodology, that could change between instructors. However, our study provides useful data on the prevalence and characteristics of musculoskeletal injuries in BJJ athletes. This information is valuable for health professionals working with martial arts and brings light to future research in BJJ athletes.

## CONCLUSION

We conclude that the prevalence of musculoskeletal injuries in BJJ athletes is high, affecting 85.2% of participants. However, this injury prevalence is similar to other martial arts. The most affected anatomical region was the knee, and there was no significant difference between the number, total frequency, and site of injuries among the different athlete levels. More studies are needed to elucidate the risk factors and develop prevention strategies for this modality.

## AUTHORS' CONTRIBUTIONS

Conceptualization, L.C.N.; methodology, B.T.S., and R.A.M.; formal analysis, B.T.S., and R.A.M.; investigation, L.C.N., C.C.P.J., R.D.S., L.M.A.F., and A.F.T.J.; resources, L.M.A.F.; writing original draft preparation, L.C.N.; writing review and editing, R.D.S. and L.M.A.F.; project administration and supervision, C.F.A.; funding acquisition, J.J.B.M. All authors have read and agreed to the published version of the manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study procedures were approved by Universidade Cidade de Sao Paulo Research Ethics Committee with protocol #224014.

## HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are the basis of this research. All the humans were used per the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013 (<http://ethics.iit.edu/ecodes/node/3931>).

## CONSENT FOR PUBLICATION

Informed consent was obtained from the participants of the study.

## STANDARD FOR REPORTING

COREQ guidelines and methodology were followed.

## FUNDING

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## AVAILABILITY OF DATA AND MATERIALS

Not applicable.

## CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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Declared none.

## SUPPLEMENTARY MATERIALS

Supplementary material and the published article are available on the publisher's website.

## REFERENCES

- [1] Gracie R, Gracie R, Peligro K. Brazilian Jiu-jitsu: Theory & Technique. 1st ed. Chicago: Invisible Cities Press 2000.
- [2] Bu B, Haijun H, Yong L, Chaohui Z, Xiaoyuan Y, Singh MF. Effects of martial arts on health status: a systematic review. *J Evid Based Med* 2010; 3(4): 205-19.
- [3] Ovretveit K. Anthropometric and physiological characteristics of Brazilian Jiu-jitsu athletes. *J Strength Cond Res* 2018; 32(4): 997-1004.
- [4] Agel J, Ransone J, Dick R, Oppliger R, Marshall SW. Descriptive epidemiology of collegiate men's wrestling injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. *J Athl Train* 2007; 42(2): 303-10.
- [5] Birrer RB. Trauma epidemiology in the martial arts. The results of an eighteen-year international survey. *Am J Sports Med* 1996; 24(6)(Suppl.): S72-9.
- [6] Birrer RB, Halbrook SP. Martial arts injuries. The results of a five year national survey. *Am J Sports Med* 1988; 16(4): 408-10.
- [7] Rainey CE. Determining the prevalence and assessing the severity of injuries in mixed martial arts athletes. *N Am J Sports Phys Ther* 2009; 4(4): 190-9.
- [8] Barsottini D, Guimaraes A, Morais P. Relação entre técnicas e lesões em praticantes de judô. *Rev Bras Med Esporte* 2006; 12(1): 56-60.
- [9] Fuller CW, Ekstrand J, Junge A, *et al.* Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med* 2006; 40(3): 193-201.
- [10] Yamato TP, Saragiotto BT, Lopes AD. A Consensus Definition of Running-Related Injury in Recreational Runners: A Modified Delphi Approach. *J Orthop Sports Phys Ther* 2015; 1-24.
- [11] Orchard JW, Walden M, Hagglund M, *et al.* Comparison of injury incidences between football teams playing in different climatic regions. *Open Access J Sports Med* 2013; 4: 251-60.
- [12] Rae K, Orchard J. The Orchard Sports Injury Classification System (OSICS) version 10. *Clin J Sport Med* 2007; 17(3): 201-4.
- [13] Critchley GR, Mannion S, Meredith C. Injury rates in Shotokan karate. *Br J Sports Med* 1999; 33(3): 174-7.
- [14] Myers RJ, Linakis SW, Mello MJ, Linakis JG. Competitive Wrestling-related Injuries in School Aged Athletes in U.S. Emergency Departments. *West J Emerg Med* 2010; 11(5): 442-9.
- [15] Souza J. Lesões no Karate Shotokan e no Jiu-Jitsu: trauma direto versus indireto. *Rev Bras Med Esporte* 2009; 17(2): 89-93.
- [16] Vidal A, Franzói S, Lopes T, Del Conti J, Vidal A, Franchini E. Estimated aerobic power, muscular strength and flexibility in elite Brazilian Jiu-Jitsu athletes. *Sci Sports* 2011; 26(6): 329-37.
- [17] Andreato L, Franchini IE, Moraes S, *et al.* Perfil morfológico de atletas de elite de Brazilian Jiu-Jitsu. *Rev Bras Med Esporte* 2012;

- 18(1): 46-50.
- [18] Barroso B, Silva J, Garcia A, *et al.* Lesões musculoesqueléticas em atletas de luta olímpica. *Acta Ortop Bras* 2011; 19(2): 98-101.
- [19] Oliveira T, Pereira J. Frequência de lesões osteomioarticulares em praticantes de Judô. *Fitness & Performance Journal* 2008; 7(6): 375-9.
- [20] Saragiotto BT, Di Pierro C, Lopes AD. Risk factors and injury prevention in elite athletes: a descriptive study of the opinions of physical therapists, doctors and trainers. *Braz J Phys Ther* 2014; 18(2): 137-43.
- [21] Saragiotto BT, Yamato TP, Hespanhol LC Junior, Rainbow MJ, Davis IS, Lopes AD. What are the main risk factors for running-related injuries? *Sports Med* 2014; 44(8): 1153-63.
- [22] Jarret GJ, Orwin JF, Dick RW. Injuries in collegiate wrestling. *Am J Sports Med* 1998; 26(5): 674-80.
- [23] Snook GA. Injuries in intercollegiate wrestling. A 5-year study. *Am J Sports Med* 1982; 10(3): 142-4.
- [24] Hewett TE, Pasque C, Heyl R, Wroble R. Wrestling injuries. *Med Sport Sci* 2005; 48: 152-78.

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