

Original Article

Women Brazilian Jiu-jitsu practitioners showed a higher incidence of concussion: an epidemiological analysis

Short title: Gender and concussion in BJJ

Gustavo Nascimento de Carvalho ¹, Rafael da Silva Rego ¹, Ana Chagas ¹,
Diana de Oliveira Schreiner ¹, Felipe Guimarães Teixeira ¹, Naiara Ribeiro
Antonietto ², Diego Ignacio Valenzuela Pérez ³, Ciro José Brito ², Bianca
Miarka ¹

¹Laboratório de Psicofisiologia e Performance em Esportes & Combates, Programa de Pós-Graduação em Educação Física, Escola de Educação Física e Esportes, Universidade Federal do Rio de Janeiro – Rio de Janeiro (RJ), Brasil.

²Programa de Pós-Graduação em Educação Física, Universidade Federal de Juiz de Fora – Governador Valadares (MG), Brasil.

³Magister en Ciencias la Actividad Física y Deportes Aplicadas al Entrenamiento Rehabilitación y Reintegro Deportivo, Universidad Santo Tomás – Santiago, Chile.

***Corresponding author:** Diego Ignacio Valenzuela Pérez. Escuela de Kinesiología – Facultad de Salud, Universidad Santo Tomás, Santiago, Chile. Address: Av. Ejército Libertador 146, Santiago, Región Metropolitana, Chile

E-mail: diegovalenzuela@santotomas.cl

Conflict of interests: nothing to declare. **Funding:** Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro E-26/202.810/2019 (247397).

Received: 08/01/2021. Accepted: 11/10/2021.

ABSTRACT

Knowledge about the prevalence of concussion in combat sports is important information to keep athletes' and practitioners' physical integrity in different modalities such as Brazilian jiu-jitsu (BJJ). Therefore, this study aimed to compare concussions incidence in BJJ between men and women practitioners. A randomized sample of 779 (689 men and 90 women) BJJ practitioners (age: 32.4 ± 9.8 years, training-time: 57.3 ± 54.4 months, training frequency: 3.4 ± 1.3 times/week). The injury analysis was done using a questionnaire with demographic data and a survey about concussions. The main results showed that women had a significantly higher frequency of concussions in training than men [38 (41%) women vs 147 men (20,5%); $p \leq 0.001$]. Furthermore, women had a significantly higher frequency of loss of consciousness than men [13 (8.8%) men vs 4 (11%) women; $p = 0.009$], among the symptoms resulting from a concussion, headache, dizziness, and loss of balance, represented the most common symptoms in those affected by concussion, regardless of gender. The results of this study may be helpful to athletes, coaches, and federations to prevent this type of injury, mainly in women.

KEYWORDS: martial arts; epidemiology; injury; concussion; sport.

INTRODUCTION

Brazilian jiu-jitsu (BJJ) is a grappling combat sport that uses takedowns, submission, chokehold, and joint locks techniques (Moriarty, Charnoff, & Felix, 2019). Victory in a BJJ match is reached through a submission or points system (Santos Silva Lopes et al., 2019). BJJ has a high level of musculoskeletal injuries, mainly in the elbows, knees, hands, and feet areas (McDonald, Murdock Jr., McDonald, & Wolf, 2017). However, with diagnosis and concussions evaluation development, this traumatic injury has now the attention of health professionals who work in high-level BJJ (Doperak, Anderson, Collins, & Emami, 2019).

As a grappling combat sport that uses takedowns, there is a potential brain injury risk, such as a concussion (Agel, Ransone, Dick, Oppliger, & Marshall, 2007; Pocecco et al., 2013; Miarka et al., 2018; Petrisor et al., 2019). Concussion results from brain inertia and cranial acceleration during impact, which can cause deformation and intracranial pressure (Rowson et al., 2016). This type of injury causes a metabolic crisis in the brain, interrupting the passage of ions through the neural membrane and a decrease in adenosine triphosphate to correct the flow of ions to keep tissues changing for weeks (Rowson et al., 2016; Doperak et al., 2019). These metabolic changes may present cognitive, neuropsychiatric, sensitive, and behavioural alterations (Doperak et al., 2019).

Two studies have detected the incidence of injury in martial arts practitioners and found concussion and head injuries to be the most frequent (Karpman, Reid, Phillips, Qin, & Gross, 2015; Bromley, Drew, Talpey, McIntosh, & Finch, 2018). At most tournaments, medical staff is present for athlete injuries (Bromley et al., 2018). In addition, prevention can be designed into three broad categories: primary prevention (i.e., health promotion and specific protection against risk factors), secondary prevention (i.e., early detection, early treatment of health problems), and tertiary prevention (i.e., reducing complications associated with health problems already sustained). A Translating Research into Injury Prevention Practice framework (TRIPP) model looks at primary prevention (Mayer et al., 2015). In some cases, injury has occurred because injured athletes were allowed to continue fighting (Karpman et al., 2015; Bromley et al., 2018). Combats and training could be stopped through an analysis to reduce the likelihood of severe injury.

Recent studies showed that the prevalence of concussions in BJJ athletes occurred in 25% of the related cases, considering the severity of this type of injury being this number considered high in the sport (Kreiwirth, Myer & Rauh, 2014; Scoggin et al., 2014; McDonald et al., 2017). Furthermore, women are 2.6 more likely to suffer a concussion than men (Spano, Risucci, Etienne, & Petersen, 2019). However, this fact can be related to women being more likely, to tell the truth about injuries than men or to anatomic differences between genders (Rowson et al., 2016). This information is still unclear since most studies only include men as samples (Petrisor et al., 2019; Santos Silva Lopes et al., 2019). Previous studies reported these causes and effects of concussion in BJJ (Kreiwirth, Myer & Rauh, 2014; Scoggin et al., 2014; McDonald et al., 2017; Spano et al., 2019).

However, the specific way concussion happens in women and men in BJJ is unknown. This information about gender differences in this sport may help trainers develop specific activities for these athletes according to their necessities (Brandt et al., 2019; Fernández, Brito, Miarka, & Díaz-de-Durana, 2020). Knowing that few studies describe the pattern of concussions events in BJJ fighters and the characteristics of these events in each gender, it is necessary to do new research on this subject. Therefore, this study aims to verify the concussions incidence between men and women in BJJ practice and to understand the main symptoms in both groups. We hypothesize that there are gender differences in the incidence of concussion and associated symptoms.

METHOD

This is an epidemiological study with a cross-sectional design.

Participants

The present study is a documental study that uses a database that shows concussion cause-effect in BJJ fighters (Spano et al., 2019). This database has 758 questionnaires answered by the athletes with public access (available at <https://www.mdpi.com/2075-4663/7/2/53/s1>). 779 BJJ practitioners were evaluated in this study (689M/90F) with a median age of 31 ± 13 yrs. with BJJ training three times/week.

The sample calculation for 550 thousand federated practitioners obtained an $n= 665$, with a 99% confidence level and 5% margin of error, using Equation 1 (Francis et al., 2010):

$$n= N Z^2 p (1-p)(N-1) e^2 + Z^2 p (1-p) \quad (1)$$

The interpretation of each of these elements is made as follows: $n=$ is the sample size obtained through the calculation; $N=$ total population belonging to the survey; $Z=$ indicated deviation from the acceptable mean value for the confidence level to be reached; $e=$ is the maximum margin of error that the search allows; $p=$ is the proportion we want to find in the calculation.

There are no modifications in participants' training, nutrition, or hydration status, following previous protocols (Miarka et al., 2019). There are no ethical problems in public data investigation and secondary data as described in previous protocols (Petrisor et al., 2019; Spano et al., 2019). This research has previously received permission from the local ethics committee after the WMA Declaration of Helsinki. The following inclusion criteria were applied: a) living in the USA; b) being a BJJ practitioner officially associated with the International Brazilian Jiu-jitsu Federation (IBJJF). As exclusion criteria were: a) practitioners younger than 18 yrs.; b) not answering the questionnaires; and c) multiple answered questionnaires (Spano et al., 2019).

Procedures

An online link to the questionnaire was sent to 42 BJJ masters, or those responsible for the academies, and directly replicated through the social networks of approximately 75 BJJ schools and associations located in the United States. The questionnaire was hosted by the Survey Monkey platform, which was programmed to filter, not allowing multiple responses from the same IP. A total of 791 practitioners completed the Survey in whole or in part; 13 participants were excluded because they were identified as under 18.

Measurements

The questionnaire consists of 17 questions, starting with demographic data and a previous survey on concussions suffered. The questions were related to age, gender, the number of times they suffered a concussion before joining BJJ, and how many times they suffered a concussion or became unconscious. Furthermore, the questions were related to the practice of Jiu-jitsu: training time, frequency of weekly practice, and the total competitions the athlete has participated in, as indicated in a previous protocol validated by Spano et al. (2019).

Statistical analysis

The data were analyzed using SPSS software version 20.0 (SPSS, Chicago, USA). Descriptive data are presented as a percentage and absolute frequency. The Chi-square test (χ^2) was applied to assess the frequency of data prevalence. Pearson's correlation was also performed to verify the association of factors that involve concussion with the gender of the BJJ practitioner. For all tests, the significance level of $p \leq 0.05$ was used.

RESULTS

Among the interviewed practitioners, 147 (20.5%) men responded that they had a concussion during their BJJ practice, and 38 women (41%) presented some type of concussion during the BJJ ($\chi^2 = 19.218$ $df = 2$, $p \leq 0.001$). In addition, there was a significant correlation between female sex and the occurrence of concussion in the BJJ ($r = 0.156$, $p \leq 0.001$).

Symptoms of concussion

The group of women had a significantly higher frequency of loss of consciousness than men ($\chi^2 = 9.482$ $df = 2$, $p = 0.009$). Table 1 shows the incidence of symptoms. Among these results, headache, dizziness, and loss of balance represented the most common symptoms in those affected by concussion, regardless of gender. Headache affected

76% of men and 79% of women, dizziness affected 71% of females and 67% of males, and loss of balance was present in 33% of men and 42% of women.

Table 1. Incidence of symptoms presented as a result of concussion in male and female BJJ practitioners.

Symptoms	Men (n= 147)	%	Women (n= 38)	%
Headache	112	76	30	79
Dizziness	98	67	27	71
Loss of balance	48	33	16	42
Blurred Vision	47	32	13	34
"seen stars"	69	47	19	50
Feeling in a fog	88	60	22	58
Amnesia	40	27	11	29
Concentration	60	41	16	42
Nausea	34	23	14	37
Throwing up	11	7.5	2	5
Loss of consciousness	13	8.8	4	11

Period of absence from BJJ training

Table 2 shows the results for the return post-concussion. Men presented a higher frequency of return in less than 24 hours and women between 2-5 days after concussion ($\chi^2= 29.276$, $df= 14$, $p= 0.01$). In addition, the women showed a negative correlation with immediate return ($r= -0.138$, $p\leq 0.001$). Regarding the period of return, both genders (29% of women and 26% of men) reported that after the concussion, they returned in a period of 2 to 5 days.

Table 2. Return time post-concussion between genders in BJJ. 3 men answers missing in the sample.

Post-concussion return	Male (%)	Female (%)
24 hours	24	21
2-5 days	26	29
6-7days	21	16
14 days	11	13
16-29 days	4	5
30-60 days	8	16
> 90 days	5	0

DISCUSSION

A concussion can cause persistent neurological effects in athletes, and sports entities are concerned about the increased incidence. This fact requires establishing rules that reduce mortality risk after head trauma, especially in combat sports (Bernick et al., 2021). To the best of our knowledge, no studies compare gender differences in the incidence of concussion and symptoms in BJJ practitioners. Our results indicated a higher incidence in women, showing a higher frequency of loss of consciousness and a longer delay than men. Also, women showed a significant positive correlation with the occurrence of concussion and a negative correlation with immediate return to training. It is essential to know the incidence of concussions in combat sports athletes to adopt prevention strategies to avoid recurrence. According to Brown, Grant, Evans, Leung, and Hides (2021), wrestlers with a history of concussions have a 2.35 times higher risk for severe related symptoms.

Due to the characteristics of motor actions in the BJJ and because it is a contact sport, it is expected that practitioners of this modality are constantly subject to concussions, even though it is a "grab" fight and there are no percussion blows, accidents during training and competitions are possible to be affected (Pocecco et al., 2013; Barreto et al., 2017; Miarka et al., 2018). In this sense, Li et al. (2021) observed that non-contact sports athletes had better results in neurocognitive tests — ImPACT (verbal memory, processing speed, and reaction time) compared to contact sports. Data from these neurocognitive analyses indicated that contact sports athletes showed a higher suspicion of concussions.

Among the cases of concussions observed here, the prevalence of concussions in the BJJ was noted in women practitioners. In line with our results, other studies analyzing concussion in combat sports observed an incidence of up to twice as high cases of concussion in women when compared to men (de Oliveira, Vieira, & Valença, 2011). A probable reason for this higher vulnerability in women may be the lower cervical muscle mass, responsible for absorbing the kinetic energy of the impact on the head (Di Battista, Churchill, Rhind, Richards, & Hutchison, 2020). Another reason for this result is the difference in the number of participants between the gender. The male sample has a numerical superiority of 599 practitioners, thus expanding this difference in the percentile.

A concussion can cause cognitive, physical, emotional, and somatic symptoms. However, the most commonly observed after the incident are headaches, neck pain, dizziness, and coordination deficiencies (Mucha et al., 2014; Teramoto, Petron, Cross, & Willick, 2015). The reports of these authors corroborate our findings. Nevertheless, the study of Brown et al. (2021) in 3009 combat sports athletes showed slightly different results, where the most prevalent symptoms were neck pain (49%), fatigue (41%), and difficulty sleeping (35%). Regarding the return time after the concussion, the two groups showed no significant difference. Both reported, in most cases, a 2 to 5-day wait to return to training. Despite the relatively small research field on the subject, it is understood that the return time is related to an adequate rest period, in some cases even requiring physical therapy interventions, and the early return associated with the symptoms already mentioned can be harmful to the practitioner (Hugentobler, Vegh, Janiszewski, & Quatman-Yates, 2015).

The present study can be used by coaches, athletes, and sports managers to establish strategies that can minimize the risk of concussion. Furthermore, it is also essential to guide athletes who may be affected by impacts to the head, as the absence of post-injury medical treatment can contribute to the high prevalence of symptoms (Brown et al., 2021). In this sense it is vital to establish educational campaigns for coaches, athletes, and other agents involved in combat sports to identify athletes who may be at risk or have persistent symptoms (Bernick et al., 2021; Brown et al., 2021). This research addresses stage one in BJJ of the TRIPP model, and future studies can utilize the data to investigate risk influences connected with injury in men and women practitioners. The TRIPP model can potentially regulate the training actions, rules, or levels within a BJJ context and determine the consequence of concussions in male and female athletes. New studies should be carried out in the area, with the equivalent sample number between the groups, for a better comparison and in different training and competition situations to help their prevention.

CONCLUSION

According to the present study's aims, applied methods, and limitations, it can be concluded that the incidence of concussions in the BJJ tends to be higher in female practitioners. Present data provided detail of the mechanisms and aetiology of serious

injury in male and female BJJ and can be used to develop prevention strategies for trial in this combat sport. There was no difference between genders regarding symptoms and time to return to training, and there was no difference between gender. Future advances in BJJ injury prevention will only be achieved if investigation efforts are focused on understanding the application context (i.e., descriptive analysis) for concussion prevention and developing the evidence base for their usefulness and efficacy of interventions.

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