

# Musculoskeletal injuries in judo practitioners

*Lesões musculoesqueléticas em praticantes de judô*

*Lesiones músculo-esqueléticas en practicantes de judo*

Ana Laura Gil Manzano<sup>1</sup>, Hugo Parra de Camargo<sup>1</sup>, Dayana das Graças<sup>2</sup>, Paula Felipe Martinez<sup>2</sup>,  
Silvio Assis de Oliveira Júnior<sup>2</sup>

**ABSTRACT** | Practice of judo integrates varied situations of physical contact and specific requirements, which makes it a competitive modality with a high rate of musculoskeletal injuries (MSI). This cross-sectional study aimed to describe MSI epidemiology and analyze the relationship among different characteristics and injury occurrence in judo practitioners. Casuistry was formed by 111 participants of both sexes. To gather information about injuries, a morbidity survey was used. For statistical analysis, Goodman's test of multinomial proportions was taken. Relationship among factors associated with MSI was assessed through logistic regression. We reported 135 MSI, with 65% prevalence (72 subjects), totaling 1.22 MSI/athlete. Most reports consisted of joint lesions resulting from trauma (n=50 cases, 37%); ankle sprain (25.2%) and shoulder dislocation (17.8%) were the cases with the highest frequency. Regarding bone lesions, there was higher proportion of serious cases (25 cases; 18.5%). Sex and weekly workload constituted the main predictive characteristics for MSI occurrence in Judo ( $p < 0.001$ ). The conclusion was that joint traumatic lesions on ankle and shoulder were the main MSI in Judo. The male sex and bigger weekly workload constituted the main predictive characteristics for lesion in Judo practitioners ( $p < 0.001$ ).

**Keywords** | Martial Arts; Athletic Injuries; Epidemiology.

**RESUMO** | A prática de judô integra situações variadas de contato físico e exigências específicas, tornando-o uma modalidade competitiva e com alto índice de lesões musculoesqueléticas (LME). Este estudo transversal teve por objetivo descrever a epidemiologia de LME e

analisar a relação entre diferentes características e a ocorrência de lesão em judocas. A casuística integrou 111 participantes de ambos os sexos. Para tomar informações sobre lesões, utilizou-se um inquérito de morbidade referida. Para análise estatística, foi empregado o teste de Goodman de proporções multinomiais. A relação entre fatores associados com LME foi avaliada por meio de regressão logística. Foram relatados 135 LME, com prevalência de 65% (72 esportistas), totalizando 1,22 LME/atleta. A maioria dos relatos foi constituída por lesões articulares decorrentes de traumas (n=50 casos, 37%), sendo que entorse de tornozelo (25,2%) e luxação de ombro (17,8%) foram os casos com maior frequência. Entre as lesões ósseas, verificou-se maior proporção de casos graves (25 casos; 18,5%). Sexo e carga horária semanal constituíram-se como as principais características preditivas para ocorrência de LME no judô ( $p < 0,001$ ). Conclui-se que as lesões articulares traumáticas em tornozelo e ombro foram as principais LME no judô. Sexo masculino e maior carga horária semanal constituíram-se como as principais características preditivas de lesão entre judocas.

**Descritores** | Artes Marciais; Traumatismos em Atletas; Epidemiologia.

**RESUMEN** | La práctica de judo integra situaciones variadas de contacto físico y exigencias específicas, tornándole una modalidad competitiva y con alto índice de lesiones músculo-esqueléticas (LME). Este estudio transversal tuvo por objetivo describir la epidemiología de LME y analizar la relación entre diferentes características y la aparición de lesión en judocas. La

<sup>1</sup>Student of Physical Therapy from the Instituto Integrado de Saúde (INISA) at Universidade Federal de Mato Grosso do Sul (UFMS) - Campo Grande (MS), Brazil.

<sup>2</sup>Professor of Physical Therapy from the Instituto Integrado de Saúde (INISA) at Universidade Federal de Mato Grosso do Sul (UFMS), Campo Grande (MS), Brazil.

casuística integró 111 participantes de ambos los sexos. Para tomar informaciones sobre lesiones, se utilizó una investigación de morbilidad referida. Para análisis estadística, fue empleada la prueba de Goodman de proporciones multinomiales. La relación entre factores asociados con LME fue evaluada por medio de regresión logística. Fueron relatados 135 LME, con prevalencia de 65% (72 deportistas), totalizando 1,22 LME/atleta. La mayoría de los relatos fue constituida por lesiones articulares derivadas de traumas (n=50 casos, 37%), considerándose que esquinche de tobillo (25,2%) y luxación de hombro (17,8%) fueron los casos

con mayor frecuencia. Entre las lesiones óseas, se verificó mayor proporción de casos graves (25 casos; 18,5%). Sexo y carga horaria semanal se constituyeron como las principales características predictivas para aparición de LME en el judo ( $p < 0,001$ ). Se concluye que las lesiones articulares traumáticas en tobillo y hombro fueron las principales LME en el judo. Sexo masculino y mayor carga horaria semanal se constituyeron como las principales características predictivas de lesión entre judocas.

**Palabras clave** | Artes Marciales; Traumatismos en Atletas; Epidemiología.

## INTRODUCTION

Classically, Judo is one of the most practiced sports in the world, consisting of a large number of technical and philosophical bases, with great value in development of individuals<sup>1,2</sup>. However, the systematic practice of judo integrates varied situations of physical contact and specific technical requirements of agility, speed, motor coordination, potency and, especially, physical strength to execute the techniques, with high competitiveness<sup>2</sup>. When combined with continuous requirement for physical and technical improvement that are common in competitive physical training, these demands can constitute predisposition factors for musculoskeletal injuries (MSI)<sup>3,4</sup>.

In the physiopathological context, in addition to specific demands of the modality, MSI occurrence has multifactorial nature and is associated with different characteristics, including intrinsic attributes such as sex, anthropometric characteristics, physical condition, training history and others<sup>3,4</sup>. Although different factors can modulate susceptibility to MSI, their isolated identification has inaccurate potential if we do not consider a possible interaction between different agents of extrinsic and/or intrinsic nature<sup>3,4</sup>. In this respect, few studies have shown relationship between these characteristics and occurrence of MSI on judo<sup>1,5-7</sup>; considering the revision by Pocecco et al.<sup>6</sup>, most of these studies are cross-sectional brief reports that integrated competition participants<sup>5-7</sup>. In addition, although joint injuries are highly prevalent<sup>5</sup>, we found no studies describing relationship between extrinsic and/or intrinsic characteristics and occurrence of specific health problems derived from the competitive Judo practice.

This study was proposed to characterize MSI occurrence and analyze relationship among different characteristics and injuries in Judo practitioners. As the initial hypothesis, it is expected that joint injuries in lower limbs caused by traumas are the most prevalent among judo sportspeople. In the physiopathological perspective, it is assumed that sex and body mass<sup>7</sup> configure the main factors associated with injuries related to the Judo practice.

## METHODOLOGY

### Nature and casuistry of the study

This study is mainly descriptive, cross-sectional and retrospective. To determine the sample size under a 95% significance level, a 98.7% minimum prevalence was stipulated, as documented in a previous study<sup>1</sup>, which integrated audience with a description similar to the casuistry of this work. Therefore, based on the population of confederate athletes who live in Campo Grande, MS, which is approximately 1,640 judo practitioners, the minimum sampling with 95 individuals was obtained for the study.

Regarding the age group, only athletes aged 12 or older were considered. In the study, we did not include volunteers with sport practice history shorter than a year or under MSI recovery or another inflammatory condition. Participants and/or their guardians were informed about the research objectives and about its participation voluntary character. All individuals or their guardians signed the informed consent form. This

research was approved by the UFMS Research Ethics Committee, under protocol number 575,782/2014.

### Registration procedures and characterization of MSI

Information collection procedures were carried out at the beginning of the 2015 season, to minimize effects of training activities and possible competitions. Information about weight and height were obtained through interviews. Data collection began with the approach of participants and/or their guardians, followed by request and registry of notes. For general characterization of volunteers, in addition to anthropometric data, information on Judo practice history, lateral dominance and category were obtained.

Information collection on MSI was accomplished through a referred morbidity survey. This tool is widely used for registration of health problems in general and does not demand clinical evaluation or complementary examination<sup>8</sup>. All collection procedures were conducted by one researcher, trained in the morbidity survey handling, since approaching of participants until protocol and clinical procedure notes. It is worth mentioning that casuistry consisted of confederate sportspeople, with competitive practice history of exactly one year or more. Several authors<sup>3,9-11</sup> used similar tools, using MSI importance for competition athletes as a justification, to collect retroactive information to long periods since the injury beginning up to the moment of the interview.

For the study's purpose, MSI was defined as any condition associated with pain and/or musculoskeletal dysfunction derived from training or competition circumstances, which causes alteration and/or interruption of sports activities' practice and training, whether in the form, duration, intensity or frequency<sup>12</sup>. The concept of sports injury used in this study was clarified for all participants at the time of the approach before interviews for information collection. Existent injuries from up to ten years of judo's regular practice were considered. Such period integrates regular activity of most participants as athletes enrolled in the Judo State Federation.

For the MSI characterization, data on occurrence, nature, frequency, anatomical location and causing condition of the injury were obtained. Regarding nature, we considered myotendinous, bone and joint injuries; for anatomical location definition, segments of the head, neck, trunk, upper and lower limbs were described. Concerning the causing condition, we

chose registry of physical training circumstances, which integrated warm up activities and resistance training at a gym, technical training, which consists of specific judo gestures without combat, or fight traumas, essentially connected to fights in training and/or competitions.

Participants were also asked about possible need of a medical-therapeutic approach request for each MSI case. This was considered on occasions which MSI reverberated in approach and treatment by a health professional<sup>13</sup>. Return to sporting activities was classified as symptomatic or asymptomatic, taking into account persistence of pain and dysfunction when returning and restarting sporting activities. Regarding sick leave duration, MSI severity was described according to three categories: mild (up to 7 days of sick leave), moderate (8–28 days) and severe (over 28 days)<sup>1,14,15</sup>.

### Statistical analysis

Results of MSI occurrence were expressed in the descriptive format. Injury rate for 1000 hours of exposure was obtained from the relationship between number of injuries and hours of exposure multiplied by 1000<sup>16</sup>. For analysis of proportion data, Goodman's test was used for contrasts between and within multinomial populations<sup>17</sup>. To investigate the relationship of factors associated with injury and MSI occurrence, a logistic regression model with binary outcome was built.

Based on the association between associated factors and Judo health issues, an analysis of injury occurrence was conducted, according to exposure workload and sex. To do it so, the variable workload was categorized into two ordinal classes, adopting the median as dichotomous measure. To compare the occurrence rate of injuries for 1000 hours of exposure according to workload and sex, the Student's t test was used. All conclusions were discussed for 5% statistical significance.

## RESULTS

Casuistry consisted of 71 men and 40 women. In the demographic and anthropometric contexts, they were aged  $22.0 \pm 7.9$ , had  $70.6 \pm 13.1$  kg body mass,  $171 \pm 10$  cm height and  $79.7 \pm 57.5$  months of judo practice. The weekly workload of judo training practice totalized  $7.54 \pm 1.67$  hours.

In the epidemiological aspect, 135 retrospective MSI cases resulting from judo practice were registered, with occurrence prevalence equivalent to 64.8% (72 participants). Occurrence rate totalized 1.22 MSI/athlete, 1.90 MSI/injured athlete and 1.36±0.87

MSI/1000 hours of exposure. All occurrences happened during competitive training periods.

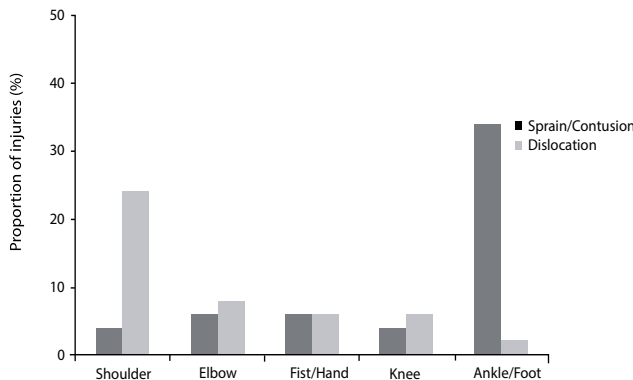
Considering MSI distribution according to nature and causal mechanism, most reports consisted of joint traumatic injuries (n=50 cases, 37%; Table 1).

Table 1. Relative (%), and absolute distribution of musculoskeletal injuries in Judo, according to nature and etiological condition

Nature	Etiological condition			Total
	Physical training	Trauma (%)	Technical training	
Myotendinous	14.6 (7)	81.3 (39)*	4.2 (2)#	100.0 (48)
Joint	7.4 (4)	92.6 (50)*	0.0 (0)#	100.0 (54)
Bone	0.0 (0)*	93.9 (31)*	6.1 (2)	100.0 (33)
<b>Total</b>	<b>11</b>	<b>120</b>	<b>4</b>	<b>135</b>

\*p<0.05 versus physical training; #p<0.05 versus Trauma; †p<0.05 Myotendinous. Goodman's test for contrasts between and within multinomial populations

Among joint injuries derived from trauma, in Graph 1, we can see that ankle sprain (17 cases, 34%) and shoulder dislocation (12 cases, 24%) were the main reported occurrences.



Graph 1. Proportion of MSI of joint nature, according to location and occurrence mechanism

Furthermore, MSI distribution according to nature and anatomical region is presented in Table 2. Bone injuries were more frequent on the upper limbs (27 cases; 20%), while the myotendinous injuries (24 cases; 17.8%) along with joint injuries (25 cases; 18.5%) were more frequent on the lower limbs. In absolute and relative terms, joint injuries on the upper limbs (26 cases; 19.3%) and lower limbs (25 cases; 18.5%) presented the main records.

MSI proportion according to nature and severity is presented in Table 3. We noticed that most reports integrated joint injuries of moderate severity (28 cases; 20.7%); and severe bone injuries (25 cases; 18.5%).

Table 2. Relative (%) and absolute distribution of musculoskeletal injuries in Judo, according to nature and occurrence anatomical region

Nature	Location				Total
	Head/Cerv (%)	UL (%)	Trunk (%)	LL (%)	
Myotendinous	0.0 (0)	41.7 (20)*	8.3 (4)#	50.0 (24)*\$	100.0 (48)
Joint	1.9 (1)	48.1 (26)*	3.7 (2)#	46.3 (25)*\$	100.0 (54)
Bone	3.0 (1)	81.8 (27)**†	3.0 (1)#	12.1 (4)#†E	100.0 (33)
<b>Total</b>	<b>2</b>	<b>73</b>	<b>7</b>	<b>53</b>	<b>135</b>

Head/Cerv: head and cervical region; UL: upper limbs; LL: lower limbs; \*p<0.05 versus Head/Cerv; #p<0.05 versus UL; \$p<0.05 versus Trunk; †p<0.05 versus Myotendinous; †E p<0.05 versus Joint. Goodman's test for contrasts between and within multinomial populations

Table 3. Relative (%), and absolute distribution of musculoskeletal injuries in Judo, according to nature and severity

Nature	Severity			Total
	Mild (%)	Moderate (%)	Severe (%)	
Myotendinous	25.0 (12)	41.7 (20)	33.3 (16)	100.0 (48)
Joint	18.5 (10)	51.9 (28)*	29.6 (16)	100.0 (54)
Bone	12.1 (4)	12.1 (4)†E	75.8 (25)**†E	100.0 (33)
<b>Total</b>	<b>26</b>	<b>52</b>	<b>57</b>	<b>135</b>

\*p<0.05 vs. Mild; †p<0.05 vs. Moderate; †E p<0.05 vs. Myotendinous; †E p<0.05 versus Joint. Goodman's test for contrasts between and within multinomial populations

Most injuries (97 cases; 72%) reflected the need for medical-therapeutic treatment. However, we found that 76 cases (56%) related with symptomatic manifestation of pain/dysfunction when returning to the activities.

Regarding the relationship between factors associated with injury and occurrence of MSI in Judo, logistic regression analysis showed that risk of injury is lower in females ( $p=0.008$ ;  $OR=0.18$ ;  $95\%CI$  0.05–0.63). In

contrast, chances of injury raise by more than 60% at each increase of 50% on weekly training hours ( $p=0.009$ ;  $OR=1.64$ ;  $95\%CI$  1.13–2.38). Regression model obtained presented a statistically significant adjustment ( $p<0.001$ ).

Table 4. Binary logistic regression coefficients for factors associated with musculoskeletal injury in Judo

Risk factor	Logistic regression				
	Coefficient	OR	95%CI		$p$ -value
			Inf. L.	Sup. L.	
Constant	3.664	–	–	–	0.522
Female	-1.738	0.176	0.049	0.629	0.008*
Age	0.043	1.044	0.956	1.140	0.336
Height	-4.900	0.007	0.000	29.716	0.247
B. M.	-0.010	0.990	0.927	1.057	0.763
T. H.	-0.008	0.992	0.978	1.007	0.314
W. T. WL.	0.496	1.642	1.130	2.384	0.009*
R. dom L.	0.407	1.503	0.422	5.344	0.529
<b>Category (Belt)</b>					
White	37.778	$2.552 \times 10^{16}$	0.000	–	1.000
Gray	38.416	$4.828 \times 10^{16}$	0.000	–	1.000
Blue	1.856	6.397	0.620	66.034	0.119
Yellow	1.611	5.006	0.452	55.447	0.189
Orange	0.726	2.068	0.204	20.979	0.539
Green	0.262	1.300	0.163	10.391	0.805
Purple	1.469	4.343	0.629	29.968	0.136
Brown	-0.204	0.815	0.126	5.279	0.830

OR: odds ratio; CI: confidence interval; Inf. L.: inferior limit; Sup. L.: superior limit; B.M.: body mass; T. H.: training history; W. T. WL.: weekly training workload; R. dom L.: right dominant limb. \* $p<0.05$

In this study, most injury cases were documented by male judo practitioners (82 cases; 60.7% out of total), which resulted in 2 MSI/injured athlete, compared with 1.71 MSI/injured athlete among females. Despite this, sample of judo sportswomen revealed higher prevalence rates (77.5% vs. 56.3% among men), higher occurrence of injuries per athlete (1.33 vs. 1.15 MSI/athlete in men) and for 1000 hours of exposure ( $1.40 \pm 0.16$  vs.  $1.26 \pm 0.14$  MSI/1000 hours in men;  $p>0.05$ ) compared with male participants.

In the women's group, the largest number of cases was concentrated among judo practitioners with a weekly exposure higher than 7 hours of training (34 MSI cases; 65.4% out of total). In addition, participants with weekly exposure higher than 7 hours of training

showed higher prevalence results (51.6% vs. 45.2%) and occurrence rate of health issues (2.13 MSI/athlete vs. 1.29 MSI/athlete), compared to the group with lower exposure, with up to 7 hours of workload. Among men, occurrence rate was expanded in the group with weekly training workload higher than 7 hours (2.71 MSI/athlete vs. 1.63 MSI/athlete).

## DISCUSSION

This study aimed to analyze MSI and investigate the relationship among different characteristics and occurrence of injuries in judo practitioners. Joint injuries resulting from traumatic conditions that



affect segmental regions of upper and lower limbs were the main records. Sex and training weekly hours were the main factors associated with MSI occurrence, therefore corroborating many of the initial hypotheses. However, the relationship between anthropometric attributes and MSI occurrence did not materialize in this study.

As well as other forms of fight and contact sports, Judo presents an important number of MSI among practitioners<sup>5,18</sup>. In this study, 135 MSI were documented derived from the systematic practice of judo and that involved the majority of participants (65%), a value similar to the rates recently seen in elite athletes<sup>19-21</sup>. Occurrence index of 1.22 MSI/athlete was very close to the value obtained by Souza et al.<sup>21</sup>, which was 1.18 MSI/athlete, analyzing high efficiency Brazilian Judo sportspeople. It is important to clarify that our casuistry fully consisted of federated sportspeople with competitive experience in several national tournaments. Approximately 45% of the sample (52 participants) belonged to the three categories of judo higher technical level: purple belt (n=13), brown belt (n=21) and black belt (n=18).

In this perspective, regardless of nature, MSI occurrence was associated with situations of trauma/contact. In the extrinsic context, judo common injuries are very related to specific movements, which include pulling, pushing, throwing, strangling and attacking techniques on the joints<sup>2</sup>. The practice of this modality is characterized by intense body contact and closed kinetic chain movements<sup>1,2,5,6</sup>, which results in important joint overload, whether in orthostatic position or in solo combat. Falls resulting from throwing and/or projections by action of the opponent have been constituting the main cause of injuries, being 70% of MSI cases<sup>22,23</sup>. Considered the perfect hit, the *Ippon* occurs due to the opponent's projection during the fall, with their back completely on the tatami, which contributes to numerous trauma situations<sup>2</sup>.

In contrast, occurrence of myotendinous injuries exceeded occurrence of joint aggravations in physical training circumstances (Table 1), integrated by warm up activities, resistance physical training or technical training. Such conditions are essentially linked to demands for strength, potency and flexibility, performed in open kinetic chain with important myotendinous overload<sup>1,2,11</sup>.

Cases of ankle sprains and shoulder dislocation constituted the main records of traumatic joint lesion

(Graph 1). Different authors<sup>4,7</sup> report that MSI on the shoulder are associated with inadequate technique, combined with falls and/or direct contact with a bigger physical shape opponent. In combat, position dynamic changes happen due to movement, requiring from the judo practitioner combinations of strength and resistance to control distance between them and the opponent<sup>1,2</sup>. In the attack gesture, we see important muscle potency demands of lower limbs<sup>2</sup>, which also overloads knees and ankles.

Considering severity of injuries, there was a higher incidence of injuries classified as severe (sick leave longer than 28 days), highlighting bone nature cases. In fact, time periods required for the recovery process and bone tissue consolidation after occurrence of fractures are on average 28 to 30 days<sup>24</sup>. Joint injuries with moderate severity (8-28 days of sick leave) had higher absolute frequency. In a systematic review, Pocco et al.<sup>5</sup> concluded that dislocations and joint sprains are more prevalent among adult athletes and elite competitors, which have higher levels of muscular strength<sup>25</sup>. As already mentioned, casuistry of this study had many competitive level athletes, being 75 adults (68%) with important history practice.

Moreover, sex and weekly hours emerged as the major associated factors with MSI occurrence. There are conflicting reports about differences in men's and women's predisposition to MSI in Judo<sup>26,27</sup>. While authors showed similarities<sup>26</sup>, there is also evidence of increased risk of MSI for men<sup>27</sup>. In the biomechanical perspective, elite sportsmen and sportswomen use similar techniques in Olympic fights<sup>28</sup>. In this sense, it is likely that the greater susceptibility of male judo practitioners is linked to greater competitiveness and/or category differences. For a reason, most cases of injury were concentrated in men in this study. Other authors found higher incidence of MSI along with technical development in the graduation process by belts<sup>29</sup>.

For improvement of athletic performance, training overloads must come along with a minor fatigue and acute reductions in performance, alternating with appropriate recovering periods<sup>30</sup>. When excessive training overload is combined with inadequate recovery, the overtraining state happens<sup>30</sup>. In fact, weekly exposure higher than 7 hours of training culminated in high occurrence rates of injuries in females (2.13 MSI/athlete) and males (2.71 MSI/athlete). With a bigger demand, therefore, there is the expansion of judo practitioners susceptibility to MSI.

Finally, we must clarify that Judo training in our reality is characterized by the systematic repetition of offensive and defensive techniques and, above all, “sparring”, which is based on a free fight between two or more fighters. Therefore, exhausting combat enhancement, requested in competitive Judo practice, combined with the lack of physical preparation resulting from a non systematic training, may have cooperated to higher occurrence of traumatic MSI, mostly linked to combat occasions. Possibly, these characteristics contributed to the minority role of other etiological and specific conditions of the judo physical and technical training, including biomechanical and physiological requests as MSI causing mechanisms in this study.

In addition to these limitations related to convenience sampling, we cannot reject the possible retrospective memory bias of the participants, considering the cross-sectional design of this investigation. Therefore, further studies need to be conducted to confirm whether findings of this study are also observed in longitudinal analyses, and among athletes from other places and judo training centers. Similarly, it is important to investigate the potential of preventive interventions, such as segmental proprioceptive training, with the aim of applying preventive measures for treatment and preservation of athletes’ health.

## CONCLUSION

Joint traumatic lesions on the ankle/foot and shoulder were the main MSI in Judo. Male sex and higher weekly workload were the main factors associated with MSI occurrence in Judo athletes.

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