EPIDEMIOLOGY AND ASSOCIATED FACTORS FOR CAPOEIRA-RELATED MUSCULOSKELETAL INJURIES: A CROSS-SECTIONAL STUDY

EPIDEMIOLOGIA E FATORES ASSOCIADOS DAS LESÕES MUSCULOESQUELÉTICAS RELACIONADAS A CAPOEIRA: UM ESTUDO TRANSVERSAL

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Abstract: Background: Capoeira has been described as beneficial in several aspects, but one of the possible consequences of its growing popularity is the increased account of musculoskeletal injuries among practitioners. An understanding of Capoeira-related musculoskeletal injuries can help sports physical therapists and other health professionals implement preventive strategies. **Objectives:** To determine the prevalence of Capoeira-related musculoskeletal injuries and to identify possible associated factors. **Methods:** This was a cross-sectional study with 520 capoeira practitioners. Survey Web links were emailed to capoeira practitioners associated with specialized groups in Brazil. The Survey collected demographic information, training characteristics and history of Capoeira-related musculoskeletal injuries in the past 12 months. The prevalence of Capoeira-related musculoskeletal injuries was analyzed by descriptive statistics and associated factors by logistic regression models. **Results:** Most capoeira practitioners (n=411, 79.0%) were men, with a mean age of 29.6±7.6 years old and who trained 3 times a week, over 90 minutes per day, for an average of 13 years of practice. The variable that showed association with Capoeira-related musculoskeletal injuries was weekly training frequency (OR=2.26 95%CI 1.38–3.69). **Conclusions:** The prevalence of injury was 42.9% (n= 223), and the knee was the most affected joint. The training frequency above 3 times per week was associated with Capoeira-related musculoskeletal injuries.

Keywords: Prevalence; Sports injuries; Epidemiology; Prevention.

Resumo: Introdução: A capoeira tem sido descrita como benéfica em vários aspectos, mas uma das possíveis consequências de sua crescente popularidade é o aumento do número de lesões musculoesqueléticas entre os praticantes. Uma compreensão das lesões musculoesqueléticas relacionadas à capoeira pode ajudar fisioterapeutas esportivos e outros profissionais de saúde a implementar estratégias preventivas. **Objetivos**: Determinar a prevalência de lesões musculoesqueléticas relacionadas à Capoeira e identificar possíveis fatores associados. **Métodos**: Trata-se de um estudo transversal com 520 praticantes de capoeira. Os links da Web da pesquisa foram enviados por e-mail para os praticantes de capoeira associados a grupos especializados no Brasil. A Pesquisa coletou informações demográficas, características de treinamento e histórico de lesões musculoesqueléticas relacionadas à Capoeira nos últimos 12 meses. A prevalência de lesões musculoesqueléticas relacionadas à Capoeira foi analisada por estatística descritiva e os fatores associados por modelos de regressão logística. **Resultados**: A maioria dos praticantes de capoeira (n=411, 79,0%) eram homens, com idade média de 29,6±7,6 anos e que treinavam 3 vezes por semana, mais de 90 minutos por dia, com uma média de 13 anos de prática. A variável que apresentou associação com as lesões musculoesqueléticas relacionadas à capoeira foi a frequência semanal de treinamento (OR=2,26 IC95% 1,38–3,69). **Conclusões**: A prevalência de lesão foi de 42,9% (n= 223), sendo o joelho a articulação mais acometida. A frequência de treinamento acima de 3 vezes por semana foi associada a lesões musculoesqueléticas relacionadas à Capoeira.

Palavras-chave: Prevalência; Lesões esportivas; Epidemiologia; Prevenção.

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INTRODUCTION

Capoeira is a traditional Brazilian cultural manifestation that consists of an offense and defense system including elements from dance, fight, and play[1–5]. Considered by many as a complete sport - as it involves body agility, coordination, balance, strength, and flexibility[5–8] capoeira is present not only in Brazil but also in many other countries around the world, [9–12] being recognized by UNESCO (United Nations Educational, Scientific and Cultural Organization) as an immaterial heritage of humanity.[3,13]

The practice of capoeira has been described as beneficial in many aspects[8–12,14,15]; however, one of the consequences of its growing popularity is the increase in the number of musculoskeletal injuries among the practitioners. Very few studies have checked the prevalence of Capoeira-related musculoskeletal injury. In the study by Gomes Neto et al[16], the body regions frequently injured were the knee and ankle. In the study by Signoreti and Parolina[17], 16 capoeira practitioners were assessed, and 68.7% suffered some kind of injury, where the ankles and feet (31.2%) were the most affected joints. Regarding practitioners who reported injuries, 91.6% had an average of 11 years of practice, thus suggesting that experience is an important variable for investigation.

The biomechanics of capoeira involves rotations and sudden, high-velocity movements that generate impact to the body. These activities with repetitive movements, high impact, and overload increase the chances of injury, especially when the athletes are not well conditioned or have poor motion quality.[1,5,7,11,17]

Understanding the epidemiology of Capoeira-related musculoskeletal injuries becomes fundamentally important when the Capoeira is considered a high-impact sport. Knowledge on the epidemiological profile of Capoeira practitioners and the associated factors with musculoskeletal injuries may help to develop preventive strategies with a multidisciplinary approach[18]. In this context, physiotherapists; physicians; athletic trainers; and other health care professionals could facilitate more effective actions to reduce Capoeira-related musculoskeletal injury.

There is a scarcity of studies that evaluated biomechanical and epidemiological aspects in this population[6,19]. Accordingly, the objectives of this study were to determinate the prevalence of Capoeira-related musculoskeletal injury in the last 12 months; to investigate the possible associated factors.

METHODS

2.1 Design and Participants

We conducted a cross-sectional study between June and September of 2016. The sample size calculation of this study was designed to detect an odds ratio (OR) of 1.4 with a power of 80% with 5% significance, resulting in 200 participants. The sample was composed of 520 capoeira practitioners, with 411 (79.0%) men and 109 (21.0%) women. We included Capoeira practitioners if they were 18 years old or older and at least 6 months of experience in Capoeira, and we excluded if they were not able to

practice capoeira because of medical restrictions or did not answer the questions regarding musculoskeletal injuries. This study was approved by the Research Ethics Committee of the This study was approved by the Research Ethics Committee of the Federal University of Ceara (#1.615.860), and all participants signed written consent form.

2.2 Procedures and Measures

An e-mail invitation was sent to 2,000 Capoeira practitioners associated with specialized groups. This invitation redirected the participants to an online self-reported questionnaire composed of 3 parts: a) participants' characteristics and lifestyle; b) training characteristics (weekly training frequency, hours of training per day, etc.); and c) history of Capoeira-related musculoskeletal injuries in the past 12 months. Participants who reported any injury had to cite a maximum of the 3 injuries. In order to help identify the body regions, a body chart was provided[20,21].

We adopted the definition of Capoeira-related musculoskeletal injuries based on previous studies with other populations, and we considered as any Capoeira-related musculoskeletal complaints and severe enough to keep away from training.[22,23] The type of musculoskeletal injury was divided into 3 categories: microtrauma, direct trauma, and indirect trauma. The microtraumatic injuries were considered related to overtraining, with a gradual onset and without an identifiable causal factor. The direct traumatic injuries were caused by a contact event, such as a fall or collision with another practitioner[24]. The indirect traumatic injuries did not involve contact, such as during landing, cutting and sudden rotations over the knee[25].

2.3 Data analysis

Descriptive statistics were utilized to describe the participants' characteristics and verify the prevalence of musculoskeletal injuries. Continuous variables were compared between practitioners with injury and no injury by the independent *t* test. The Pearson's chi-squared test was used to compare the categorical variables. To test the association between the variables (personal data and training characteristics) with Capoeira-related musculoskeletal injuries, a bivariate logistic regression analysis was conducted. The variables that showed association with Capoeira-related musculoskeletal injuries with a $p \leq 0.20$ were submitted to multivariate logistic regression by the Backward: Wald method. We used the coefficient of determination R^2 of Nagelkerke to verify the quality of the prediction of the final model. Results were presented as OR and 95% confidence interval. All the analyses were performed in the SPSS software version 20.0 with a significance level of $\alpha \leq 0.05$.

RESULTS

The prevalence of Capoeira-related musculoskeletal injuries in the past 12 months was of 42.9% (*n*=223). Regarding the body region, the knee was the most affected joint, consisting of 28.4% (*n*=93) of all injuries. The main reported injuries were microtraumatic (50.6%; *n*=166),

followed by indirect traumatic (33.2%; *n*=109). Regarding the number of injuries, most of the participants (65.0%; *n*=145) reported only one injury in the past 12 months (Table 1).

Tabela 1. Description of the body region, type and number of injuries presented by capoeira practitioners.

Body region	% (n)	Type of injury	% (n)	Nº injuries	% (n)
Knee	28.4 (93)	Microtrauma	50.6 (166)	One	65.0 (166)
Shoulder	18.3 (60)	Indirect trauma	33.2 (109)	Two	22.9 (51)
Low Back	13.7 (45)	Direct trauma	16.1 (53)	Three	12.1 (27)
Ankle/Feet	13.1 (43)				
Wrist/Hand	12.8 (42)				
Hip/Thigh	8.5 (28)				
Forearm/Elbow	1.8 (6)				
Upper Back	1.2 (4)				
Others	2.1 (7)				

Participant's characteristics were categorized in 2 groups: practitioners with injury, and no injury. As shown in Table 2, the variables that presented significant differences between groups were age, education level, weekly training frequency, if practice of other sports, and experience time.

Tabela 2. Characteristics of the study participants.

Variables	All (n= 520)		With injury (n= 223)	No injury (n= 297)	*p*
Age (years)†	29.6 ± 7.6		30.83 ± 7.4	28.6 ± 7.4	0.001*
BMI (kg/m²)†	25.7 ± 3.7		25.8 ± 3.5	25.5 ± 3.8	0.32
Sex‡					
Female	21.0 (109)		38.5 (42)	61.5 (67)	0.32
Male	79.0 (411)		44.0 (181)	56.0 (230)	
Education level‡					
Up to primary education		13.3 (69)	30.4 (21)	69.6 (48)	
Up to secondary education		42.1 (219)	35.2 (77)	64.8 (142)	0.001*
Up to Tertiary education		40.8 (212)	53.8 (114)	46.2 (98)	
Postgraduate		3.8 (20)	55.0 (11)	45.0 (9)	
DUL‡					
Right	86.1 (447)		43.8 (196)	56.2 (251)	0.31
Left	13.8 (72)		37.5 (27)	52.5 (45)	
DLL‡	74.8 (388)				
Right	25.2 (131)		44.6 (173)	55.4 (215)	0.20

Left			38.2 (50)	61.8 (81)	
Weekly training frequency‡					
1-2 days/week	31.1 (160)		36.3 (58)	63.8 (102)	
3 days/week	39.0 (201)		39.8 (80)	60.2 (121)	0.001*
>3 days/week	29.9 (154)		55.2 (85)	44.8 (69)	
Duration of training ‡ (hours)					
≤1h30m	41.1 (211)		44.1 (93)	55.9 (118)	0.59
>1h30m	58.9 (302)		41.7 (126)	58.3 (176)	
Other sports‡					
No	58.3 (302)		38.1 (115)	61.9 (187)	0.01*
Yes	41.7 (216)		50.0 (108)	50.0 (108)	
Capoeira-specific Footwear‡					
No	81.7 (425)		40.2 (171)	59.8 (254)	0.10
Yes	18.3 (95)		54.7 (52)	45.3 (43)	
Experience time† (months)		155.6 ± 105.5	173.0 ± 110.2	142.5 ± 100.0	0.001*

†: continuous variables were presented as means and standard deviations (independent t test); ‡: categorical variables were presented as percentages and absolute numbers (Pearson's Chi-squared test). *Significant difference between capoeira practitioners "with injury" and "no injury"; BMI: Body Mass Index; DUL: Dominant Upper Limb; DLL: Dominant Lower Limb.

Most of the Capoeira practitioners showed a body mass index (BMI) classified as healthy. Regarding the weekly training frequency, 39.0% (*n*=201) of the participants practiced 3 times per week, and 58.9% (*n*=302) had a training session longer than 90 minutes. Table 3 shows the participants' characteristics in detail.

Seven variables of all analyzed characteristics were eligible for the multivariate logistic regression: age, education level, weekly training frequency, duration of training, practice of other sports, Capoeira-specific footwear, and experience time (Table 3). The weekly training frequency was the only variable that remained in the final model and showed significant association with Capoeira-related musculoskeletal injuries (Table 4). This proposed model explains 11.4% of the total variance assessed by the coefficient of determination R^2 of Nagelkerke.

Table 3. Profile of the capoeira practitioners and bivariate logistic regression model.

Variables	**Distribution % (n)**	**OR (CI 95%)**	***p***
Age (years)		1.04 (1.01 – 1.06)	0.001*
BMI (kg/m²)			
Healthy	44.6 (224)	1	-
Overweight	43.8 (220)	1.24 (0.85 – 1.80)	0.26
Obese	11.6 (58)	1.08 (0.60 – 1.94)	0.78
Sex			
Female	21.0 (109)	1	-
Male	79.0 (411)	1.25 (0.81 – 1.93)	0.30
Education level			
Up to primary education	13.3 (69)	1	-

Up to secondary education	42.1 (219)	0.95 (0.38 – 2.39)	0.91
Up to Tertiary education	40.8 (212)	0.44 (0.17 – 1.11)	0.08*
Postgraduate	3.8 (20)	0.35 (0.13 – 0.99)	0.04*
Weekly training frequency			
1 to 2 days/week	31.1 (160)	1	-
3 days/week	39.0 (201)	1.16 (0.75 – 1.78)	0.49
>3 days/week	29.9 (154)	2.16 (1.37 – 3.40)	0.001*
Duration of training (hours)			
≤1h30	41.1 (211)	1	-
>1h30	58.9 (302)	0.90 (0.63 – 1.29)	0.59
Other sports			
No	58.3 (302)	1	-
Yes	41.7 (216)	1.62 (1.14 – 2.31)	0.007*
Capoeira-specific Footwear			
No	81.7 (425)	1	-
Yes	18.3 (95)	1.79 (1.114 – 2.81)	0.01*
Experience time (months)		1.003 (1.001 – 1.004)	0.001*

OR: *Odds Ratio*; CI: Confidence Interval; *Eligible variables for the multivariate logistic regression model.

Table 4. Multivariate logistic regression model.

Variable	Crude OR (CI 95%)	Adjusted OR (CI 95%)	*p*
Weekly training frequency			
1 to 2 days/week	1	1	-
3 days/week	1.16 (0.75 – 1.78)	1.21 (0.77 – 1.90)	0.41
>3 days/week	2.16 (1.37 – 3.40)	2.26 (1.38 – 3.69)	0.001*

OR: *Odds Ratio*; CI: Confidence interval; *Significant difference.

DISCUSSION

The purpose of this study was to determinate the epidemiology and associated factors with Capoeira-related musculoskeletal injuries. We identified an epidemiological profile of the sample in which most participants were youth men, healthy, experienced in Capoeira, and they also trained longer than 90 minutes per day.

Regarding these characteristics, our study presents some similarities with other studies conducted with capoeira practitioners, such as mean age, BMI, weekly training frequency, and experience time[5–8,12,17]. Only one study had a mean age of participants higher than we observed in our study[16]. Regarding the proportion of men and women, most of the studies did not show this information or selected only one gender as an inclusion criterion[6–8,12,17]. Otherwise, the studies that presented this information were conducted with a much smaller sample than our study[5,16]. Regarding the

experience time, our study showed a higher average in comparison with previous studies[5,7,17]. Only one study investigated if capoeira practitioners were practicing other sports and showed similar results as our study, in which most participants practiced only Capoeira[17]. The prevalence rate that we found was of 42.9% similar to the study conducted by Signoretti and Parolina[17] which also observed a high prevalence (68.7%). However, no limit of time was determined to record of injuries, and this may to be a critical bias, in addition to the sample size was much small (n=16).

Microtraumatic injuries were the most common injuries among the practitioners, followed by indirect traumatic injuries. The body region most affected was the knee, which is the same finding as observed in other study[16]. One of the possible reasons for the high injuries account in this joint is the biomechanics of the Capoeira, which involves quick displacement, sudden rotations, and forced landing[1,5,7,11]. These mechanisms are crucial factors for knee injuries and have been described in several studies that analyzed other sports, such as basketball, handball, soccer, and volleyball[26–30].

Participants who practiced Capoeira with footwear were more exposed to injuries, according to the bivariate analysis. This can be explained because there are no cushioning mechanisms in Capoeira-specific footwear, although we should carefully interpret what it was not significant in multivariate analysis. In contrast to we observed in the literature for other health conditions, the low education level was not related to musculoskeletal injuries[31–33]. Nevertheless, age may be considered a confounding factor for educational level, because older participants had higher education level.

The multivariate analysis showed that practicing Capoeira more than 3 times a week was the only training characteristic that presented a significant association with Capoeira-related musculoskeletal injuries. This association may be explained by fatigue and cumulative overload are greater when the exposure time is high, thereby increasing the probability of the practitioner developing an injury, as it was already observed in studies with other populations[24,34–36]. However, no association between the variables of session time and experience time was observed in our study.

The results of this study are relevant because they provide new information about the prevalence and modifiable associated factors for Capoeira-related musculoskeletal injuries. This is the first study using a consistent sample that provides information regarding the epidemiological profile of the Capoeira practitioners more susceptible to injury. In addition, it shows some characteristics that may be addressed by clinicians to develop preventive strategies. Moreover, future cohort studies are required to establish the cause-effect relation of Capoeira-related musculoskeletal injuries.

CONCLUSION

The prevalence of Capoeira-related musculoskeletal injuries in the past 12 months was 42.9%. The more frequent injuries in Capoeira practitioners were microtraumatic, where the

knee was the most affected body region. The training frequency of more than 3 days per week was the only training characteristic associated with Capoeira-related musculoskeletal injuries.

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