

# Prevalence and risk factors of musculoskeletal injuries in parkour

- Authors' Contribution:**
- ☑ **A** Study Design
  - 📁 **B** Data Collection
  - 📊 **C** Statistical Analysis
  - 📄 **D** Manuscript Preparation
  - 📁 **E** Funds Collection

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## Abstract

- Background & Study Aim:** Parkour is a sport (extreme forms of physical activity) which consists in transposing barriers using body skills. Few studies investigated the prevalence of injuries in this sport. The aim of the study is the knowledge of the frequency and location of the damage within the body of people practicing parkour in Brazil.
- Material and Methods:** We conducted a cross-sectional observational study. Sample selection was by convenience. The study included 91 individuals ( $19.0 \pm 4.6$  years) practitioners of Parkour with minimum experience of six months in the sport. We collected data on the prevalence of injuries and associated factors using a structured questionnaire.
- Results:** The prevalence of injury was 61.5%, most frequently in the lower limbs (57.1%). Among the factors associated with injury, the variables that showed significant differences between injury-group and no-injury-group were age ( $p = 0.005$ ) and average hours of training ( $p = 0.024$ ).
- Conclusions:** The prevalence of injuries observed in parkour was high and major in lower limbs. Regarding associated factors, age and duration of training session were variables associated with injuries. Other studies should be encouraged with a view to develop preventive strategies for this sport.
- Keywords:** cross-sectional study · extreme forms of physical activity · extreme sport · injury prevention
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**Extreme forms of physical activity** – include all professional activity or voluntary service as well as all varieties of physical activity that fulfil at least one classification criterion of the feature associated either with extreme risk of injury or death, or extreme body burden with high level of effort, or extreme coordination difficulty [1, p. 20].

**Parkour** (French pronunciation: *par'kuʁ*) – other sources indicate that parkour developed in France, primarily by Raymond Belle, David Belle, and Sébastien Foucan during the late 1980s [27].

## INTRODUCTION

Parkour is a new extreme sport (in a broad sense is the *extreme forms of physical activity* [1]), which consists in overcoming obstacles in the environment using body skills such as jumping or scaling. Its name comes from French language and means “to trace a path”. Its practitioners, the parkouristes, are called “traceur” (men) and “traceuse” (women) [2, 3].

The history of the sport began in the late 80s and its founders used to practice gymnastics, climbing and martial arts [4, 5]. However, the most important influence in the development of this sport originated from the Natural Method of Georges Hébert [6]. Hébert was a great leader in the development of modern physical education, developing a training system grounded on principles like courage, action and altruism [6, 7]. He described what he called “natural skills” and classified them into 10 different categories: walking, running, jumping, climbing, crawling, balancing, load, shoot, defend and swim [4]. As in other countries the practice of parkour has been disseminated in Brazil mainly due to the internet and recent action movies. Just like any sport, especially those involving high performance and competition, it is common occurrences of injury or the onset of musculoskeletal disorders [8, 9]. There are not competitions in parkour which prevent data acquisition on injuries. However, it is plausible that this sport has a high rate of injuries. Only few studies reported the occurrence of injuries in parkour [10-13] and there is no consensus regarding the factors that may predispose participants to injury. Such condition interferes with the development of the parkour practice and complicates the use of appropriate preventive strategies. The aim of the study is the knowledge of the frequency and location of the damage within the body of people practicing parkour in Brazil.

## MATERIAL AND METHODS

This observational cross-sectional study was performed in 2012-2013. The sample was selected by convenience. Practitioners of parkour with a minimum of six-month experience in the sport were selected to participate of this study. Participants who concurrently held other sports practice or who had a history of fractures in upper and lower limbs were excluded.

This study was approved by the Ethics Committee of the Pitágoras Faculty of Montes Claros – Brazil (205.127/12). All subjects were informed about the

objectives of the study and signed an informed consent prior to data collection.

To characterize the sample, a structured questionnaire adapted from the studies of Pastre [14] and Morgado [15] was applied. The questionnaire comprised questions regarding sex, work activity, age, weight, height and Body Mass Index (BMI).

To analyse the prevalence, injury was considered any pain or musculoskeletal disorder that has limited or prevented by one or more days the athlete’s training in the last six months [16]. Participants were also asked to identify the location of the lesion.

To verify the factors associated with the injury, the participants were divided into two groups: those who have been injured (IG) and those who have not been injured (CG) while practicing Parkour. Age, sex, education, duration of training, practice time, average weekly workouts and flexibility training has been verified.

Descriptive statistics were performed to characterize the sample. One Way ANOVA was used to analyse the differences between the groups for continuous variables while the Mann-Whitney U test was used for nonparametric variables. In inferential analysis, it was considered a level of significance  $p = 0.05$ . All data were analysed using the SPSS software version 17.

## RESULTS

The total of 91 individuals participated in this study including eight women (8.7%) and 83 males (91.3%). The sample consisted of students (67%), physical education teachers (5.5%), systems analysts (5.5%), technicians (4.4%), administrative assistants (3.3%) and other professions (14.3%). The descriptive characteristics of participants, average training sessions per week and the average training session duration are shown in Table 1.

**Table 1.** Descriptive characteristics of the sample (n = 91).

Variáveis	Mean ± SD
Age (years)	19.0 ± 4.6
BMI (Kg/m <sup>2</sup> )	21.9 ± 1.9
Training per week (frequency)	2.6 ± 1.4
Training duration (hours)	2.3 ± 1.3

Regarding practice time in the sport, the more experienced practitioners showed more than 72 months of

practice (3.0% of the sample) while the less experienced reported six months of practice (14.0% of the sample). More than half of the parkourists have less than three years of practice (54.0%).

Regarding the prevalence of lesions, 56 athletes (61.5%) reported having suffered a musculoskeletal injury while practicing parkour in the last six months, 39% of whom reported having experienced two or more lesions. In 23 cases (41%), injuries have prevented athletes from training for more than four weeks and two participants reported the need for referral to emergency medical care due to the severity of the injury.

Generally, the lower limbs (foot/ankle, leg, knee) had more than half of the injuries (57.1%). However, injuries have been reported in almost all body segments (Table 2).

**Table 2.** Musculoskeletal injuries derived from the practice of parkour by body region (n = 56)

Body region	Number of injuries	Percentage (%)
Ankle / foot	16	28.6
Knee	10	17.8
Leg	06	10.7
Shoulder	04	7.1
Wrist	04	7.1
Head	03	5.3
Pelvis	03	5.3
Arm	02	3.6
Elbow	02	3.6
Abdomen	01	1.8
Cervical spine	01	1.8
Lumbar spine	01	1.8
Upper back	01	1.8
Thigh	01	1.8
Fingers (feet and hands)	01	1.8

Comparing IG and CG while practicing parkour, there was significant difference for age. The mean age of the IG was  $20.2 \pm 4.2$  years while the average CG was  $17.4 \pm 4.7$  years ( $p = 0.005$ ). Significant difference was also observed for the daily training duration: IG trained  $3.4 \pm 1.3$  h/day while the CG had a mean of  $2.8 \pm 1.2$  h/day ( $p = 0.024$ ). The other associated factors investigated showed no significant differences between groups ( $p > 0.05$ ).

## DISCUSSION

From the data analysis, we found that Parkour is a sport played mainly by young males and that this activity can be considered democratic, taking into account the range of professionals who practice it. Most practitioners presented eutrophic during data collection and most athletes reported having suffered a musculoskeletal injury in the past six months.

In a recent study of Puddle et al. [16], the authors demonstrated that strategies of landing in parkour are less stressful during contact with the ground in comparison to the traditional approach which may reduce the risk of injury. However, several case reports of injuries are related to parkour and most refers to bone fractures [11, 12, 18].

McLean et al. [11] reported a fracture of the distal tibia and fibula in a 13 year old male parkouriste. In another study, Miller and Demoigny [17] reported a severe injury in a teenager of 18 years with multiple fracture/dislocations of the left mid-foot with dislocation of the second digit after falling from a height. Moreover, Frumkin et al. [18] reported bilateral fracture of the calcaneus of a 19-year old male, while McLean et al. [12] presented two other cases: a 13 year old male adolescent who fractured tibia and distal fibula and a practitioner of Parkour of 15 years who fractured mid-shaft right clavicle and distal radio.

Few studies have addressed the prevalence of lesions in parkour and their results are conflicting. Wanke et al. [13] in a study of 266 practitioners of parkour, observed 1.9 acute injuries per year and most affected region are upper limbs (58%). These findings are intriguing considering that in the present study was observed higher prevalence of lower limb injuries (57.1%). However, it was not possible to observe if different training techniques would be responsible for such differences.

Parkour can be considered a sport of high risk for injuries [19] Nevertheless, comparing our results with studies of other non-extreme sports, we observed that parkour showed similar rates of musculoskeletal injuries. For example, in a study with professional and amateur gymnasts, was found an injury rate of 76.7% [20]. In another study, the incidence of injury in recreational runners was 79% in a six-month period of observation [15]. Thus, it is possible to observe that the rate of injury in parkour is equivalent to rates observed in other sports considered less harmful.

However, we emphasize that the injuries of parkour are severe. Because 41% of injured athletes in this study were unable to train this sport for at least four weeks and two individuals had to seek medical emergency care.

Investigations of sports injuries are very difficult due to methodological aspects such as the criterion of the concept of injury. In the present study, we considered any injury pain or disorder that has limited or prevented the athlete's practice for one or more days in the last six months [15]. However, other concepts of injury are also widely used. Rudzki et al. [21] and Fauno et al. [22] considered nosological diagnosis of injury in their studies. On the other hand, Pollock et al. [23] considered injury as an event which prevents the athlete's training for at least a week. Moreover, Pope et al. [24] described that injury arises when the individual is unable to complete daily activities without signs and symptoms within three days. Thus, standardization is crucial so that results can be compared objectively.

Analysing the factors associated injuries, significant differences for age ( $p = 0.005$ ) were observed. It is possible that the physiological and biomechanical changes that affect the musculoskeletal condition

of the individual may favour the occurrence of these differences [22, 25]. Average hours of training per day was another variable with significant difference ( $p = 0.024$ ). Is possible to suggest that adults have greater caution in conducting this type of activity and that training should not be longer than three hours.

Among the limitations of this study, we emphasize the memory bias for the determination of injury and the cross-sectional study design that limits the inference of causality. Furthermore, the number of participants is only moderate.

## CONCLUSIONS

The prevalence of injuries observed in parkour was high and major in lower limbs. Regarding associated factors, age and duration of training session were variables associated with injuries. Other studies should be encouraged with a view to develop preventive strategies for this sport.

## COMPETING INTERESTS

The authors declare that they have no competing interests.

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