

## Activity Profile Analysis of Footvolley Athletes: Association with Injuries

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### Abstract

**Background:** Footvolley is a sport played on the beach sand in which the athletes can pass the ball using certain body areas and are not allowed to touch the ball with their upper limbs. These repeated passes involving the ball's impact with associated fast movements and displacements on an irregular floor can cause injuries. This study aimed to determine the activity profile during a national footvolley competition in order to verify which technical gestures were the most common in a footvolley match and to determine both the epidemiology and risk factors for injuries in footvolley athletes.

**Methods:** The sample was composed of 36 male footvolley athletes, aged 21 to 48 years, who competed in the National Footvolley League Championship in Portugal. The instrument of measurement consisted of a questionnaire and camcorders to film the athletes, and the footvolley activities were analysed using V-Note Video Analysis Software.

**Results:** The footvolley movements that were most performed were attack, defence or pass using the head (35.6%), followed by the chest (21.9%). Twenty-five (69.4%) athletes reported having suffered an injury since the beginning of their footvolley career and 15 (41.7%) referred to having an injury in the last 12 months. The most injured body areas were the lumbar (29.4%) and cervical (23.5%) spine, and the most frequent type of injuries were low back pain (29.4%), neck pain (23.5%) and muscle injury (23.5%).

**Conclusion:** This study showed that injuries are very common in footvolley players. It's necessary to create injury prevention strategies, including specific training.

**Keywords:** Footvolley; Activity Profile; Injuries; Epidemiology; Risk Factors

### Introduction

Footvolley was created by Octavio de Moraes in 1965 in Brazil and has increased in popularity, gaining international recognition. This sport is played barefoot on the beach sand by two teams, with each team having two players [1-3] (Figure 1).



**Figure 1:** Footvolley practice.

Footvolley's goal is to score more points than the opposing team. The game starts after the serve that consists of kicking the ball, which is positioned at the end of the court, with the foot over the net to the opponent's team court. The first player keeps serving until a point is lost. When the first team regains the service, the second player has to serve. Each team can give a maximum of three touches (reception - setup - attack) using the foot, thigh, chest, shoulder or head until they pass the ball over the opposing team's net again. A player is not allowed to hit the ball twice consecutively [1,2].

During a footvolley competition, it is necessary to make repeated contact with the ball that impacts several areas of the body (i.e., foot, thigh, chest, shoulder or head) and movements on the sand that consists of an irregular floor. The performance of these gestures involves intermittent high-intensity bouts interspersed with stationary periods without the ball. These movements are repeated throughout the footvolley competition and therefore require high muscular endurance, moderate cardio-respiratory endurance, and anaerobic power, besides balance and neuromuscular coordination with quick reflexes [1]. The repetition of these gestures with impacts (touches) and associated movements on an irregular floor may cause injuries.

The identification of the number of movements in body joint could provide more relevant data to help us to developing appropriate training protocols and preventing injuries programs. Thus, time motion analysis should be an integral part of this process [4,5]. Time motion analysis refers to the frame-by-frame examination of video footage of each athlete during training or competition, which registers the recording of time and distance data, movement patterns, frequency, mean duration and total time spent in activities [5].

Until now, there haven't been any studies performed using video analysis of footvolley training or competition.

### Aim of the Study

The study aimed to determine the activity profile during a Portuguese footvolley competition in order to verify which technical gestures were the most common in a footvolley match and to determine both the epidemiology and risk factors for injury in footvolley athletes.

### Methods

A cross-sectional descriptive survey was used to collect data in this study. The study was approved by the Piaget Institute's Research in Education and Community Intervention (RECI) Unit, Portugal.

### Population

The study population comprised male footvolley athletes who competed in the National Footvolley League Championship, which consisted of five stages and a final stage.

Inclusion criteria specified individuals who practiced the modality for a period more than 1 year, with age equal or above 18 years old, who freely agreed to participate in the study and signed the consent form, and they were attending at least a 1-week training session.

### Measurement instruments

#### Injury questionnaire

The questionnaire consisted of socio-demographic characterization of the population, aspects related to modalities and specific questions about the injuries.

The last part of the questionnaire was focused on the occurrence of injuries resulting from footvolley practice in three different periods: at the time of data collection, since the beginning of their footvolley career, and over the last 12 months. The athletes who presented with an injury in the last 12 months were asked to continue to fill out the questionnaire answering the injury characteristics. It was only possible for respondents to specify the characteristics of a maximum of three injuries (those considered most serious and/or needing more time for recovery).

An injury was defined as any condition or symptom that occurred as a result of footvolley training or competition and had at least one of the following effects: the athlete had to stop the activity (training or competition) for at least 1 day; the athlete didn't have to stop the activity, but had to modify it (i.e. fewer hours of training or competition, lower intensity of effort, or was less able to perform certain gestures or movements/techniques); the athlete sought advice or treatment from health professionals to address the condition or symptom [6,7].

The questionnaire was evaluated by a group of five experts with different backgrounds and a pre-test were carried out with 10 athletes; it applied in a single session by the investigator in the form of a structured interview.

### Set analysis

Each athlete was individually recorded for the entire duration of the set(s). All video recordings were obtained by an evaluator positioned in order to have the best view of the athlete.

V-Note video analysis software 2.1.2 was used to evaluate the movements of each athlete during the competition, in order to account for the time spent in each activity. The time pattern of each footvolley activity was analysed; however, as each technical gesture had a duration of one thousandth of a second, we decided to count the number of repetitions of each gesture (the frequency and the percentage of occurrence of each activity).

The cameras used were recording at 30 frames per second. For the video analyses, we used the velocity of 0.5 to 15 frames per second.

**Data analysis**

Descriptive statistics were obtained regarding all variables in the study. Afterwards, the injury proportion (IP) and injury rate (IR) were calculated.

The influence of the included variables on the presence of injury was assessed using binary logistic regressions, based on the Enter method; crude odds ratios (OR) and respective confidence intervals (CI) were also calculated.

In all inferential analysis, statistical significance was set at 0.05.

The statistical analysis was performed with the Statistical Package for Social Sciences (SPSS), version 26.0.

**Results**

The sample was composed of 36 male athletes between 21 and 48 years old (33.83 ± 7.17 years).

Ten athletes (27.9%) practiced the modality between 1 and 4 years, 14 (38.8%) between 5 and 10 years and 12 (33.3%) had more than 10 years of practice. As for the training frequency, 10 (27.8%) trained up to 2 times a week, 13 (36.1%) athletes trained 3 times a week, 13 (36.2%) between 4 and 7 times. Regarding the duration of training per session, 9 (25%) athletes trained up to 1 hour and a half, 19 (52.8%) up to 2 hours and 8 (22.2%) between 3 to 4 hours.

Twenty-one (58.3%) athletes said that they performed another sport, and 29 (80.6%) referred that they performed warm-up before training or competing, with the duration of between 3 and 30 minutes (12.28 ± 7.07).

Eight (22.2%) athletes said they were injured at the time of the data collection, and 25 (69.4%) athletes reported having suffered some type of injury since the beginning of their footvolley career (totalling 47 injuries during their entire careers). For the 12-month period, 15 (41.7%) athletes referred to having an injury related to footvolley training or competition, with 13 athletes (86.7%) reporting only one injury and 2 (13.3%) reporting two injuries (totalling 17 injuries).

An IP of 0.42 (CI 95%: 0.26 - 0.58) injuries per athlete per 12 months was obtained. The resulting IR was 1.62 injuries per 1,000 hours of footvolley training.

The average number of injuries per athlete (total number of injuries/total number of athletes) was 0.47, and the average of injuries per injured athlete (total number of injuries/total number of injured athletes) was 1.13.

Table 1 shows relative and absolute frequencies of the type and location of the injuries. This table only refers to the body areas affected by injuries.

Type of injury	Location of injury	Number	%
Muscle injury (strain, contusion)	Thigh	3	
	Leg	1	
	All	4	23.5%
Meniscal injury	Knee	1	
	All		5.9%
Sprain	Ankle	1	
	All	1	5.9%
Tendinopathy	Knee	1	
	All	1	5.9%
Low back pain	Lumbar spine	5	
	All	5	29.4%

Neck pain	Cervical spine	4	
	All	4	23.5%
Others	Pelvis	1	
	All	1	5.9%
Any type of injury	Cervical spine	4	23.5%
	Lumbar spine	5	29.4%
	Pelvis	1	5.9%
	Thigh	3	17.6%
	Knee	2	11.8%
	Ankle	1	5.9%
	All		100%

**Table 1:** Type and location of injury.

Eleven (64.7%) athletes reported that the injury occurred during training, five (29.4%) reported that the injury occurred during competition and one (5.9%) reported an injury during the warm-up period.

Regarding the mechanism of injury, nine (52.9%) injuries were caused by performed technical gestures, three (17.6%) by performed rotational movements or changes of direction, two (11.8%) by sprints, one (5.9%) by floor impact, and two (11.8%) by other causes. The technical gestures that caused injuries involved foot defence (2; 11.8%), head attack (4; 23.5%), pass with chest (2; 11.8%) and pass with foot (1; 5.9%).

Table 2 shows the relationship, obtained from the application of the binary logistic regression model, between the occurrence of injury over the last 12 months and the age group, years of footvolley practice, weekly frequency and duration of training, and performed warm-up. No analysis was statistically significant.

Variables	Odds Ratio crude (CI 95%); p-value
Age group (until 29 years)* ≥ 30 years	1.0 (0.25 - 4.08); ≥0.05
Years of practice (≥ 6 years)* until 6 years	1.26 (0.33 - 4.74); ≥0.05
Weekly training (≥ 3 times)* until 2 times	2.8 (0.63 - 12.71); ≥0.05
Duration of training per session (until 1.30 hours)* > 1.30 hours	1.6 (0.33 - 7.77); ≥0.05
Perform warm-up (no)* yes	1.06 (0.2 - 5.6); ≥0.05

**Table 2:** Relationship between the event the presence of injury and variables about non-modifiable sample factors and footvolley practice characteristics.

\*: Reference class.

There were 24 sets played in these championships, out of which 96 videos were made and analysed. Each game had four players and each of them were analysed individually; in addition, some players could have played more than once in the same championship and could have participated in the two stages of the championship. Table 3 shows the number of repetitions of each footvolley activity performed during the two stages of this Championship.

Footvolley movements	N	Percentage
Serve	536	13.7
Attack, defense or pass with the head	1,397	35.6
Attack, defense or pass with the shoulder	183	4.7
Attack, defense or pass with the chest	859	21.9
Attack, defense or pass with the thigh	116	3.0
Attack, defense or pass with the foot	782	19.9
Bicycling	38	1.0
Shark-attack	13	0.3

**Table 3:** Number of repetition of each footvolley movements.

*Serve:* Movement of kicking the ball, which is positioned at the end of the court, with the foot, over the net to the opponent’s team court; *Bicycling:* A movement in which the player tilts his body back in the air, while leaning with one leg and placing the other one above the head region, aiming to hit the ball in an aerial throw; *Shark attack:* Movement that attacks the ball with the plantar foot, making a forceful attack (Figure 2).

### Discussion

Footvolley is a sport that can cause a high number of injuries, with 69% of the athletes being injured over the course of their career and 42% in a 12-month period. Since there is only one study that verified the prevalence of injuries in footvolley players, it is difficult to compare our data. The only study found was by Alves., *et al.* [8] who evaluated 69 footvolley athletes, not referred to as amateurs or competitors and verified a prevalence of injuries in 27 (39%) athletes throughout their entire time playing footvolley.

This high prevalence of injuries can be explained by the fact that it is not as popular a sport as collective sports, such as soccer, and, because of this, it is believed that most athletes are not followed by a multidisciplinary team, such as a physical trainer, physiotherapist, orthopaedist, psychologist and nutritionist. The fact that the athletes do not have training follow-up with a team of professionals can lead them to improper training in terms of intensity and correction of technical gestures, which can increase the risk of injuries. However, this fact was not analysed in this study and is only considered an assumption.

Although a high percentage of athletes have enough experience in the practice of the sport (33% of athletes practiced footvolley more than 10 years), they were more likely to develop injuries if they performed the movements improperly without some professional who corrected the execution of technique. Data from our study indicated that the performance of technical gestures was the main mechanism of injury (53%).

Most athletes (64.7%) who participated in our study reported that their injury occurred during training; this result should be analysed in order to elaborate a specific training protocol, with adequate frequency and duration of training and rest.

Besides that, 28% of athletes trained with a weekly frequency equal to or less than two times. Training frequency can be an important factor in injury prevention, since, according to American College of Sports Medicine (ACSM) [9], a training prescription should include at least three training sessions per week if it were to obtain training effects, such as the improvement of cardiovascular conditioning and muscle hypertrophy. Training less than 3 times a week can lead to fatigue at an earlier stage and worsen the stability of musculoskeletal structures. Although statistical significance was not obtained, data from binary logistic regression obtained in this study revealed that athletes who trained less than three times a week had higher chances of developing injuries.

Considering the technical gestures of footvolley, it is necessary to perform repeated contact with the ball that impacts several areas of the body. The data of our study verified that the most used anatomical body parts were the head (36%), followed by the chest (22%) and the foot (20%). This finding is in agreement with the types of injuries and the most injured bodily area (the cervical spine (24%); this repetitive movement of the head and its association with the ball's impact can cause neck pain.

Low back pain (29%) was the most frequent complaint observed in our study. This result can be explained by the fact that the sport involves jumping and repetitive touches in the chest area (22%). To perform the chest touches, the athlete has to open the arms so that the ball strikes exactly in the sternal region of the chest with associated knee half-flexion, keeping the spine in a neutral position. However, some athletes may perform this movement incorrectly, performing hyperextension of the lumbar spine. This movement is associated with a jump and added to the impact of the ball imposes an overload on the lumbar spine. In addition, during the match, the athlete performs several rotational movements of the spine, which in the long term may lead to early degeneration of the intervertebral discs; 18% of injuries were caused by rotational movements or changes of direction.

In addition to the repeated gestures with touches and rotational movements, the athlete has to reach for the ball, which stretches the lower limbs to their maximum. This can cause muscle strain, which, in our study, was also a very frequent type of injury (24%).

Data from the study of Alves., *et al.* [8] revealed that the knee was the most injured location (27%), followed by the lumbar spine (24%), thigh (12%), foot (12%), cervical spine (8%), pelvis (8%), leg (6%) and shoulder (3%).

To our knowledge, this survey is the first study that analysed the epidemiology of musculoskeletal injuries in footvolley athletes and its gesture profile. Since the sport has become popular in both competitive and non-competitive forms, further studies are required to expand the knowledge on injuries associated with footvolley and their prevention as well as to provide more detailed information on the movements and exercises that potentially cause most injuries. Besides that, orthopaedists and sports physicians should be familiar with this type of sport so that they can properly counsel and treat their patients.

This study presents some limitations because interviews for data collection rely on the participant's memory and thus may not be objective; however, recall bias is a well-documented limitation of population-based cross-sectional injury surveys<sup>10</sup>. Another limitation of the study was the fact that the reported injuries were not evaluated by health professionals, but more often than not corresponded to self-made diagnoses, making the reliability of their classification questionable. As previously mentioned, footvolley is not a well-known sport. As a result, clubs do not have sponsorships to finance the best conditions for the athletes, such as physical preparation and medical monitoring, making it difficult for health professionals to control injuries.

### Conclusion

This is the first study investigating footvolley-specific injuries in a championship.

The data of this study showed that injuries are very common in footvolley players. The most affected body regions were the lumbar and cervical spine. The body areas that footvolley player's most used during this championship were head and chest, and for these, repetitive use associated with the impact of the ball can lead to these injuries observed in this study.

Footvolley is a sport that is becoming increasingly popular in both competitive and non-competitive forms, thus further studies are required to expand the knowledge on injuries associated to this practice to provide more detailed information on the movements and exercises that potentially cause most injuries.

### Conflict of Interest

None.

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