



## Preventive Physiotherapy Applied to Portuguese Surf Athletes: Association in Improving Performance and Reducing the Number of Injuries

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### Abstract

**Background:** Surfers are constantly subjected to suffer injuries that can result from environmental exposure, unpredictability in performing the maneuvers, contact board, involvement with the wave and/or excessive training. Physical therapy applied to surfers aims to prevent common injuries of this activity, improving the physical performance of the athlete. This study determined the prevalence of injuries in surf athletes and the association of preventive Physiotherapy in the reduction of the number of injuries and the athlete's performance.

**Methods:** The sample was constituted of 101 Portuguese federated surf athlete's aged between 10 - 44 years. The measuring instrument was a questionnaire administered during the Regional Surf Circuit, Portugal.

**Results:** Fifty-seven (56.4%) athletes reported having suffered some type of injury during surfing. Within those who performed preventive Physiotherapy (12; 11.9%), 9 (75%) improved the number of riding waves and within the ones who didn't perform, only 35 (40.2%) improved their performance. Older athletes have 2.82 (95% CI: 1.03-7.72; p = 0.044) more probability to have an injury than younger, and athletes who didn't perform preventive Physiotherapy had 9.95 (95% CI: 1.21-81.87; p = 0.033) more chance to have an injury.

**Conclusion:** Preventive Physiotherapy seem to be a factor that can contribute to the improvement of athletic performance and the reduction the number of surfers injuries.

### Introduction

According to the International Surfing Association [1] there are 35 million surfers in over 70 countries. According to the Portuguese Surfing Federation [2], there are about 10,000 federated athletes, 70 clubs and 140 schools in Portugal. Practice of surfing on a competitive level include variances such as muscular strength and endurance, balance and proprioception of high intensity. In addition to the high intensity imposed on the athlete, this is also subject to external factors such as the different ocean currents, wind orientation, the type of ocean floor, the size of the waves, the water temperature, the contact with the board and other surfers, amongst others; these factors require athletes to exhibit quick and efficient adaptations [3].

The normal surfing session lasts approximately two hours [4], but it is not uncommon for competitive surfers to get three to four hours in the water and to be surfing more than once per day [5]. For instance, the injury of paddling can occur because of repeat motion, related to long-time paddling. The profile of activities during an international competitive surfing cup was investigated in 42 male surfers that were filmed, and it was found that the paddling corresponded to 51% of the total time, the period in which the athlete was stationary was 42%, wave riding accounted for 4% of total time, and other activities accounted for 2% of the total time (e.g., duck diving, recovering the surfboard) [6].

Some common movements to surf such as hyperextension of the trunk during the paddling and the violent nature of some vertical surf maneuvers have been reported to cause injury in the lumbar, cervical and shoulder regions [4].

Regarding the material used for surfing, this has undergone an evolution to meet the new demands of the practice of this sport, such as surfboards becoming lighter and shorter (shortboard), allowing greater speed and better hydrodynamics, which allowed greater diversity of maneuvers, increasing the risk of injury [4,7].

The design of the short boards (narrow/small) allows quick changes of direction and maneuvers with greater speed that cause high stress on the knee, causing sprains of the knee. The size of this board also determines a lower fluctuation, which causes an instability [7]. Thus, surfers are at risk to suffer acute injuries such as sprains, lacerations, strains and fractures [7].

The preventive Physiotherapy applied to surfers aims at preventing common injuries of the sport as well as improving the physical performance of the athlete. It mainly consists of proprioceptive and plyometric training, which allow the individual to establish relationships with the environment, providing information on the position of the articular segments of your movement pattern, being an important factor in sign correction in dynamic stability and injury prevention.

Studies on the effectiveness of preventive Physiotherapy in the surf athletes are unknown. Thus, the aim of this study was to determine the prevalence of injuries in surf athletes and verify the association of preventive Physiotherapy in the reduction of the number of injuries and the athlete's performance.

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## Methods

The design of this epidemiological study was observational, analytical and cross-sectional. Athletes who agreed to participate in the study signed an informed consent form and were informed about the objectives of the study, told they could give up at any time, ensuring them the confidentiality of the results, the self-determination and privacy, respecting thereby the ethical principles of investigation. Thus, this study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki).

### Population

The population consisted of Portuguese federated athletes of surf, of any age, of both sexes. Inclusion criteria cumulatively involved athletes who participated in the 2<sup>nd</sup> stage of the Regional South Surf Circuit and the 2<sup>nd</sup> and 3<sup>rd</sup> stages of the Regional Surfing Circuit of Lisbon, in Portugal during 2015, who wanted to participate voluntarily in the study and signed the informed consent form.

### Measurements

The measuring instrument consisted of a questionnaire administered in a single moment during the course of the championships. The questionnaire was administered by the researcher, who merely clarify doubts which emerge, without interfering with their opinions or producing biased answers.

The 2<sup>nd</sup> stage of the Regional South Surf Circuit was held at Quarteira beach, Algarve region, between 15<sup>th</sup> and 16<sup>th</sup> of February 2015, the 2<sup>nd</sup> stage of the Regional Surfing Circuit of Lisbon was held at Carcavelos beach in days 7<sup>th</sup> and 8<sup>th</sup> of March and the 3<sup>rd</sup> stage of the Regional Surfing Circuit of Lisbon was held on 30<sup>th</sup> and 31<sup>st</sup> of March on the beach of Costa da Caparica.

The questionnaire consisted of two parts. The first part of the questionnaire involved questions about the age, sex, years of practice, regularity of training per week, duration of each training session, perform other sport with regularly (at least 2 times a week), type of board used and number of waves caught per training hour at the moment and 6 months ago, and questions concerning the realization of preventive Physiotherapy.

The question about the number of waves caught per training hour is dependent on sea conditions, so it was requested to the athlete who made an average of waves picked that particular month.

The prevention Physiotherapy considered in this study included sensorimotor and/or plyometric training to simulate the movements performed in the surf off of water. This type of training is relatively recent in Portugal and has acquired many participants to improve the conditioning and the necessary techniques for performing the modality. Although surfing technique is highly specific and out-of-water simulation seems to be impossible, this prevention program that mimics the sport-specific demands of surfing can assist surfers to improve the fitness level.

In the second part of the questionnaire the athlete also had to answer about the type of injury, location of injury, if the injury occurred during training practice or during competition, the mechanism of injury for each type of injury, if treatment was required for the injury, and finally, if so, the treatment performed.

The injuries were considered along the surf practice, since this beginning, resulting from the practice of surf, in order to verify the lifetime prevalence of injury. The athlete should refer two types of injuries: the most common injury that presented and the injury that more limited and/or prevented the athlete from practicing surf. The most common injury (frequent injury) was one that an athlete had more than once and the injury that more limited and/or prevented the athlete from practicing surf (limiting injury) was considered the most severe lesion in which the athlete had to cease surfing practice/training or alternatively make training modifications to continue practice as a consequence of the injury.

Validated questionnaires about the surf injuries, especially for the Portuguese population, are unknown. Therefore, the administered questionnaire was designed by the authors and analyzed by a group of physiotherapists with experience in sport injuries and by a group of professional surfers with extensive experience.

The injury was defined as a body damage resulting from a external force applied directly or indirectly, with or without disruption of structural continuity [8].

### Data analysis

Initially, descriptive statistics were analyzed for all variables in the study. Chi-square Independence tests were then applied in order to evaluate associations between performing preventive Physiotherapy with the presence of injury and with the physical performance of athlete.

The influence of the variables used in this study on the presence of injury was assessed using binary logistic regressions, based on the Enter method (using all selected variables), and crude and adjusted odds ratios (OR) and respective confidence intervals were presented. A final multivariate model was developed, using the forward likelihood method, and its validity, quality of fitting and predictive capacity were assessed by Omnibus and Hosmer-Lemeshow tests and the Nagelkerke correlation coefficient.

The statistical analysis was performed with the Statistical Package for Social Sciences (SPSS), version 22.0 (IBM SPSS Statistics, IBM Corp, New York: USA). Statistical significance was set at 0.05.

### Results

The sample consisted of 101 surf athletes aged between 10 and 44 years ( $19.2 \pm 7.2$  years), with the majority being male (85.1%).

Most athletes trained for more than 10 years (26; 25.7%), 10 (9.9%) athletes trained just one year, 19 (18.8%) trained between 2 and 3 years, 16 (15.8%) of 4 and 5 years, 15 (14.9%) trained between 6 and 7 years and 15 (14.9%) between 8 and 9 years. Concerning the frequency of weekly training, 6 (5.9%) athletes trained once a week, 28 (27.7%) athletes twice a week, 24 (23.8%) trained three times a week, 20 (19.8%) trained four times per week, 8 (7.9%) trained five times a week and 15 (14.9%) every day. Most athletes trained between 1 and 2 hours per day (56; 55.4%), 28 (27.7%) athletes trained between 2 and 3 hours, 10 (9.9%) between 3 and 4 hours and 7 (6.9%) trained between 4 and 5 hours.

Twenty-five (24.8%) athletes performed another type of sport with a weekly frequency equal to or greater than 2 times, plus surf. Most athletes used the shortboard (97%) and only 4% used longboard. With regard to therapy, only 12 (11.9%) athletes performed preventive Physiotherapy, 2 (2%) athletes performed physiotherapy to treat an injury, and the majority (87; 86.1%) had no therapy.

Fifty-seven (56.4%) athletes reported having suffered some type of injury during surfing, 40 (39.6%) athletes referring injury as the most frequent and 54 (53.5%) referring limiting injury.

Within the 40 (100%) athletes who reported frequent injury, 39 (97.5%) reported that the injury occurred during training and only 1 (2.5%) athlete said the injury occurred during the competition. Most athletes (36; 90%) said they did some kind of treatment to treat the injury, and the majority opted for physical therapy (21; 60%), followed by the rest (6; 17.1%) and medication (3; 8.6%).

With regard to injury more limiting and/or preventing the athlete to practice their sport, 43 (91.5%) athletes reported that the injury occurred during training and 4 (8.5%) that occurred during competitions. Forty (85.1%) athletes had some kind of treatment to treat injuries, and the majority held physiotherapy (23; 57.5%), 6 (15%) had surgery, 5 (12.5%) rest, 3 (7.5%) medication, 2 (5%) resorted to unconventional therapy and 1 (2.5%) to immobilization.

Table 1, table 2, table 3 and table 4 show the relative and absolute frequency of type, location and mechanism of injury, and the maneuvers that caused the frequent and limiting injury.

Within the athletes who had some type of injury (57; 100%), 11 (19.3%) performed preventive Physiotherapy, 2 (3.5%) did physiotherapy to treat some type of injury and the majority (44; 77.2%) didn't perform physiotherapy ( $p = 0.012$ ).

**Table 5** shows the association between the realization of preventive Physiotherapy and improvement in the number of waves trapped ( $p = 0.264$ ).

**Table 6** shows the relationship between the presence of injury and gender, age group, years of surf practice and duration of training daily, and realization of preventive Physiotherapy obtained from the application of logistic regression models. In the adjusted model, the values obtained in Omnibus, Hosmer and Lemeshow test and Nagelkerke for the absence and presence of injury variable adjusted for the others variables were respectively:  $p < 0.002$ ,  $p = 0.910$  and  $R^2 = 0.11$ .

It was found (in the adjusted model) that older athletes have 2.82 (95% CI: 1.03-7.72;  $p = 0.04$ ) more probability to have an injury than younger athletes, and athletes who didn't perform preventive Physiotherapy had 9.95 (95% CI: 1.21-81.87;  $p = 0.033$ ) more chance to have injury.

**Table 1:** Type of injury.

Type of injury	Frequent injury	Limiting injury
Bone (Fracture)	2 (5%)	8 (17%)
Ligament (rupture, sprain)	8 (20%)	12 (25.5%)
Meniscal	3 (7.5%)	2 (4.3%)
Muscular (strain, contusion)	8 (20%)	9 (19.1%)
Articular (luxation)	7 (17.5%)	6 (12.8%)
Tendon (tendinitis)	10 (25%)	5 (10.6%)
Other	2 (5%)	5 (10.6%)
Total	40 (100%)	47 (100%)

**Table 2:** Location of injury.

Location of injury	Frequent injury	Limiting injury
Cranium	1 (2.5%)	5 (10.6%)
Face	1 (2.5%)	4 (8.5%)
Cervical spine	1 (2.5%)	3 (6.4%)
Lumbar spine	2 (5%)	2 (4.3%)
Shoulder	10 (25%)	1 (2.1%)
Arm	2 (5%)	3 (6.4%)
Hands and fingers	0	1 (2.1%)
Pelvis	2 (5%)	1 (2.1%)
Knee	14 (35%)	16 (34%)
Leg	2 (5%)	1 (2.1%)
Ankle	4 (10%)	7 (14.9%)
Foot and fingers	1 (2.5%)	1 (2.1%)
Total	40 (100%)	47 (100%)

**Table 5:** Association between the preventive Physiotherapy and the physical performance of the athlete.

Physiotherapy achievement	Number of trapped waves	Worsened	Kept	Improved slightly	Greatly improved	Total
Physiotherapy to treat an injury		0	1 (50%)	0	1 (50%)	2 (100%)
Preventive Physiotherapy		2 (16.7%)	1 (8.3%)	5 (41.7%)	4 (33.3%)	12 (100%)
Not perform Physiotherapy		17 (19.5%)	35 (40.2%)	19 (21.8%)	16 (18.4%)	87 (100%)

**Table 6:** Relationship between the event the presence of injury and variables about non-modifiable sample factors and surf practice characteristics.

Variables	Odds Ratio <sub>crude</sub> (CI 95%); p	Odds Ratio <sub>adjusted**</sub> (CI 95%); p	Odds Ratio <sub>adjusted***</sub> (CI 95%); p
Gender (female)* male	2.10 (0.69-6.44); $p = 0.19$	2.15 (0.63-7.29); $p = 0.22$	-
Age group (10-19 years') ≥ 20 years	2.86 (1.08-7.57); $p = 0.35$	2.41 (0.72-8.01); $p = 0.15$	2.82 (1.03-7.72); $p = 0.04$
Years of surf practice (until 3 years') 4-7 years (4-7 years') ≥ 8 years	0.87 (0.31-2.44); $p = 0.79$ 1.62 (0.62-4.25); $p = 0.33$	0.88 (0.29-2.66); $p = 0.83$ 1.06 (0.34-3.30); $p = 0.92$	-
Duration of training daily (between 1 and 3 hours') from 3 to 5 hours	1.18 (0.41-3.39); $p = 0.77$	0.691 (0.19-2.45); $p = 0.57$	-
Preventive Physiotherapy (performs') not performs	10.75 (1.33-86.89); $p = 0.03$	13.62 (1.42-130.72); $p = 0.02$	9.95 (1.21-81.87); $p = 0.03$

\*Class reference; \*\*adjusted for gender and age group (Enter model); \*\*\*Forward LR model

## Discussion

This study revealed a high prevalence of lesions (56.4%) in athletes of the sample analyzed. Similar data were observed in the study of Santos [9] that evaluated sixty Portuguese surfers with a mean age of 27 years and the prevalence of injuries values was 56.7%. The Almeida et al. study [10] also assessed 151 Portuguese surfers, aged over 18 years, and found the presence of 246 acute injuries.

Nathanson et al. [11] obtained 1,348 completed surveys of athletes from 48 countries [most was from the United States (76%), 6% were from Australia, 5% were from England, 2% were from New Zealand, and 11% were from other countries] with average age of 28.6 years and verified the presence of 1,237 acute injuries and 477 chronic injuries. Taylor et al. [4] evaluated 646 Australian surfers, with an average age of 27 years, and found that 145 surfers presented 168 acute injuries in the preceding 12 months. Base et al. [7] evaluated 32 professional's surfers who participated in the 2005 Brazilian Championship of Surfing Professional in São Paulo, and noted the presence of 112 injuries. Woodacre et al. [12] evaluated 130 surfers in the UK, median age 28, using a web-based survey distributed to UK surfing clubs and observed that 122 surfers reported a total of 335 injuries. The difference between the prevalence of values presented in these studies can be explained by the practice of surfing place where the ocean floor characteristics, waves, water temperature and others which are different from those in Portugal.

**Table 3:** Injury mechanism.

Injury mechanism	Frequent injury	Limiting injury
Impact on sand	6 (15%)	4 (8.5%)
Impact with the board	8 (20%)	13 (27.7%)
During a maneuver	16 (40%)	24 (51.1%)
Impact with another surfer	1 (2.5%)	3 (6.4%)
Other	9 (22.5%)	3 (6.4%)
Total	40 (100%)	47 (100%)

**Table 4:** Maneuver that caused the injury.

Maneuver that caused the injury	Frequent injury	Limiting injury
Trimming	3 (18.8%)	4 (16.7%)
Cutback	0	1 (4.2%)
Bottom	1 (6.3%)	3 (12.5%)
Floater	3 (18.8%)	6 (25%)
Snap	5 (31.3%)	5 (20.8%)
Aerial	4 (25%)	5 (20.8%)
Tube	0	0
Total	16 (100%)	24 (100%)

Note: despite the trimming not be considered a maneuver but a technique to obtain higher or lower speed to perform a particular maneuver, it was included in the options of the maneuvers.

The study of Meir et al. [5] evaluated 685 surfers residing in Australia, of which 272 (38.4%) surfers reported having experienced a serious injury which impeded surfing until the injury had healed. This study revealed a higher prevalence of this type of injury, classified as limiting injury (53.5%), however this study involves only competitors surfers and in the Meir et al. [5] study most of the athletes were free style surfers, being only 3.2% professional's surfers. Steinman et al. [13] evaluated 930 surfers and 679 (73%) reported having suffered 927 injuries that required medical attention or who prevented the surfing, being most athletes free style surfers (67.5%).

The most common type of frequent injury observed in this study was classified as tendon injury (25%), followed by muscle injury (20%) and ligament injury (20%). As for the limiting injury, the most prevalent injury was ligament (25.5%), followed by the muscle (19.1%) and bone (17%) injury. Similar findings were reported in study by Santos [9] where the most prevalent injuries in competitor's surfers were classified as joint (29.2%), muscle (16.7%) and bone (16.7%) and in the Nathanson et al. study [11] observed a high prevalence of lacerations (42%), contusions (13%), sprains/strains (12%), and fractures (8%). Most lacerations and contusions are caused by fall and contact with the board, especially contact with the fin, nose and tail [3].

Taylor et al. [4] also found that lacerations (46.4%) were the most common injury, followed by sprains (28.6%), dislocations (10.7%) and fractures (8.9%). Moraes et al. [3] found that the most prevalent injuries was contusions (29%), followed by lacerations and burns (23% each), muscular and ligament injury and sprains (9% each). Base et al. [7] revealed that the lacerations were higher incidence of injuries (33.9%), followed by sprains (25.9%) and contusions (14.2%). Woodacre et al. [12] also found that the lacerations were responsible for the largest number of injuries (31%), the ligament injuries by 15%, muscle or tendon ruptures by 9%, and fractures by only 3% of the injuries. Hay et al. [14] observed 212 episodes in the Emergency Department UK service, between the years 2004 to 2006, and found that lacerations (38%) were the most common injury, followed by sprain and fractures. This study includes only the injuries that might have physiotherapy intervention, so the athlete only has the option of describing a more frequent and/or a more limiting injury, that's why the laceration wasn't included in this study.

Regarding the location of injury, the knees (35%), shoulder (25%) and ankle (10%) were the most common region in frequent injuries, and again the knee (34%), ankle (14.9%) and cranium (10.6%) were the most common region in limiting injury. Santos 'study [9] showed that lumbar spine was the most anatomic region injured in competing athletes (29.2%), then the ankle (16.7%), head, feet and fingers (12.5% each). The common position of the knee in flexion and valgus can overload the medial components of knee and the repeated movements of paddling can overload the muscle-tendon complex shoulder, especially with use of boards with low fluctuation, as short boards that have been chosen by most athletes comprised the study sample (97%) [13].

Nathanson et al. [11] revealed that 37% of injuries occurred in the lower limbs and 37% in the head and neck, the same observed in the Taylor et al.'s study [4] where the parts of the body most commonly affected are the lower limb (45.8%) and head/face (26.2%). The study of Meir et al. [5] also points lower limbs as the most common site being the knee most commonly affected (15.9%), ankle and foot (14.9%), trunk (13.9%), shoulder (13.1%) and head (12.8%), as well as the study of Moraes et al. [3] where in the professional category the most affected anatomical area was the lower limb (33%) and the study of Steinman et al. [13] where 38% of the injuries reached the lower limbs, 17.9% the upper limbs and 15.6% the head. The study by Woodacre et al. [12] revealed that the head injuries were the most common injuries (24%), followed by ankle (19%) and knee (13%).

The data from this study revealed that the most common mechanism of injury occurred during the execution of a maneuver and with an impact with the board, in both types of lesions. Most studies have shown that the most common mechanism of injury was

contact with the board [3,4,10-12]. Nathanson et al. [11] revealed that 55% of injuries resulted from contact with the own board and 12% with the board of other surfers and the region of board associated with the largest number of injuries were the fin (35%) and rail (18%). This study didn't investigate the part of the board that could cause more injuries, and suggested future studies to investigate this question, in order to create preventive measures that focus on the use of the nose guard, less sharp tails and fins made of rubberized material [3].

Taylor et al. [4] also found that contact with the surfboard or other surfer was the most common mechanism of injury (45.2%), consistent with the study by Moraes et al. [3], with a frequency of 52% of causes of injury, followed by performing a maneuver (47%).

The maneuvers that caused the most injury classified as frequent were the snap (31.3%) and aerial (25%) and in limiting injury were the floater (25%) followed by snap and aerial (20.8% each). Santos [9] also found that aerial was the maneuver that caused more injury in the competitor's surfers (25%). In aerial the board loses contact with the wave and perform a flight path to get back in touch with the wave and may have associated movements of rotations and different handles on the board, so it is a technique that requires greater technical skill, and consequently has a higher risk of injury [9]. Almeida et al. [10] found that the floater was the maneuver responsible for 7.3% of the injuries, the cutback by 6% and the tube by 4.8%. Steinman et al. [13] found that the maneuvers accounted for 35.1% of injuries, and the tube and floater the maneuvers account for 16% and 10.8%, respectively.

Nathanson et al. [15] revealed that of 116 injuries documented, 89 (76.7%) occurred during competition, data which differ from these presented in this study where most injuries occurred during training. This difference can be attributed to the type and duration of training performed by athletes, the existence of professional supervision, among other factors. For example, Santos [9] found that a time of higher weekly sports activity ( $p = 0.029$ ) or less warming-up time ( $p = 0.047$ ) corresponding to a larger number of injuries.

The treatment most sought by athletes of this study to treat their injuries was physiotherapy, data similar to those obtained by Santos [9]. Moraes et al. [3] found that the most accomplished treatment was medications (40%), stretching or resistance exercise (13%), cryotherapy and curative (7% each).

The majority of the athletes who participated in this study (86.1%) wasn't aware of preventive Physiotherapy, and athletes who had some type of injury also weren't performing preventive Physiotherapy. Athletes in this study who didn't perform preventive Physiotherapy had 9.95 more chance to have an injury; furthermore, it was found that athletes resorting to preventive Physiotherapy improved the number of waves trapped. Thus, it is believed that preventive Physiotherapy might contribute to improving the athlete's performance and reducing the number of injuries.

Beyond engaging with preventive Physiotherapy, the surfer's age (classified as a non-modifiable factor) also contributed to the increased number of injuries, where athletes aged above 20 years had 2.82 probability to have injuries. This is similar to data obtained by Nathanson et al. [11] where the older surfers had a higher relative risk of injury in which athletes aged between 20 and 29 years had 1.3 (0.9-2.0) times of occurrence of injury compared to athletes in the age group of 9 to 19 years old.

Since the aging factor cannot be modifiable, the greater number of injuries occurred during the training of athletes and the preventive Physiotherapy appear to be a factor that can contribute to the improvement of athletic performance and to reduce the number of injuries. It is suggested that surf clubs and/or schools include in their training sessions a larger component of exercises performed out of water, accompanied by an appropriate period of warm-up and return to rest, also including proprioceptive and plyometric exercises that simulate the most the movements common to this modality as a way of preventing injuries and improving physical performance of the athlete.

The main limitation of the current study was its cross-sectional nature, where no definite cause or effect could be stipulated. Since this is a cross-sectional study, it is only possible to show an association with the realization of preventive Physiotherapy and the reduction in the number of injuries, but not to demonstrate causality, being necessary to perform longitudinal and experimental studies.

The prevention Physiotherapy considered in this study included sensorimotor and/or plyometric training to simulate the movements performed in the surf off of water, however we didn't ask about the weekly frequency of conducting the prevention Physiotherapy, nor how long the athlete performed. Since this study aimed to verify the association between this prevention Physiotherapy with the presence of lesions and the athlete's performance these variables were not considered. Thus, future studies it's suggested to analyze these variables.

Another limitations of this study were the use of a non-validated questionnaire (however as previously mentioned, validated questionnaires are unknown), and sample size (especially in group which perform preventive Physiotherapy, however the awareness of preventive Physiotherapy isn't still a widespread practice and performed by surfers).

The other limitation of this study was the application of questionnaire based on self-reports with the potential for recall bias once it's relies on the memory of the participant, there is clearly room for error, especially as the rate of recall reduces as the detail of the injury increases. Furthermore, there wasn't evaluation by health professionals of the reported injuries, therefore, the reliability of the injury type can be questionable. National surfers registers of injuries are unknown for the competitive level, as recreational, so it had to opt for the account of the own surfer.

## Conclusion

This study revealed a high prevalence of lesions in athletes analyzed, being the most common type of frequent injury was tendon injury, and for the limiting injury was ligament injury, and the region more prevalent in frequent and limiting injuries was the knee. The more frequent mechanism of injury was the execution of a maneuver and the impact with the board, in both types of lesions. Athletes who perform preventive Physiotherapy had less chance to have an injury and improved the number of waves trapped. Thus, it is believed that preventive Physiotherapy seem to be a factor that can contribute

to the improvement of athletic performance and the reduction the number of surfers injuries.

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## References

1. (2016) International Surf Association.
2. (2015) Portuguese Surfing Federation (FPS).
3. Moraes G, Guimarães A, Gomes A (2013) Analysis of the prevalence of injuries in the Paraná coast surfers. *Acta Ortop Bras* 21: 213-218.
4. Taylor D, Bennett D, Carter M, Garewal D, Finch CF (2004) Acute injury and chronic disability resulting from surfboard riding. *J Sci Med Sport* 7: 429-437.
5. Meir R, Zhou S, Gilleard W, Coutts R (2011) An investigation of surf participation and injury prevalence in Australian surfers: a self-reported retrospective analysis. Southern Cross University ePublications. Gosford, NSW 44.
6. Mendez-Villanueva A, Bishop D, Hamer P (2006) Activity profile of world-class professional surfers during competition: a case study. *J Strength Cond Res* 20: 477-482.
7. Base L, Alves M, Martins E, Costa R (2007) Injuries among professional surfers. *Rev Bras Med Esporte* 13: 251-253.
8. (2016) Medical Subject Headings (MeSH).
9. Santos P (2014) Prevalência e Incidência das Lesões em Surfistas de Elite Portugueses –Comparação entre Competidores e não Competidores. [Master thesis]. Lisbon: School of Human Kinetics, University of Lisbon, Portugal.
10. Almeida J, Laíns J, Veríssimo M (2009) A contribution for the knowledge of Surf acute injuries in Portugal. *Revista da Sociedade Portuguesa de Medicina Física e de Reabilitação* 19: 18-22.
11. Nathanson A, Haynes P, Galanis D (2002) Surfing injuries. *Am J Emerg Med* 20: 155-160.
12. Woodacre T, Waydia S, Wienand-Barnett S (2015) Aetiology of injuries and the need for protective equipment for surfers in the UK. *Injury* 46: 162-165.
13. Steinman J, Vasconcellos E, Ramo, R, Botelho J, Nahas M (2000) Epidemiology of surfing accidents in Brazil. *Rev Bras Med Esporte* 6: 9-15.
14. Hay C, Barton S, Sulkin T (2009) Recreational Surfing Injuries in Cornwall, United Kingdom. *Wilderness Environ Med* 20: 335-338.
15. Nathanson A, Bird S, Dao L, Tam-Sing K (2007) Competitive surfing injuries: a prospective study of surfing-related injuries among contest surfers. *Am J Sports Med* 35: 113-117.