

# Use of a Prospective Survey Method to Capture a Picture of Overuse Injuries in Kitesurfing

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## SUMMARY

**Background.** Kitesurfing is one of the world's fastest growing Olympic aquatic sports. However, previous scientific literature on this sport has mainly focused on acute injuries. The aim of this study was, therefore, to capture a picture of the burden of overuse injuries in kitesurfing.

**Methods.** Active kite-surfers regularly completed an online questionnaire, describing the health of their shoulders, lower back and knees as well as any injury related symptoms.

**Results.** Forty-three participants completed a total of 304 questionnaires, covering a total period of 2,096 distinct person-days. Person-days of reduced participation related to shoulder, lower back and knee problems were 8 %, 3% and 8% of the total respectively. Performance was affected related to shoulder, lower back and knee problems in 11%, 22% and 16% of person-days respectively.

**Conclusions.** Overuse injuries emerged as an important predictor of reduced participation, decreased performance and discomfort in kitesurfing. The prospective survey method captured a picture of overuse injuries in kitesurfing not previously described.

## KEY WORDS

*Aquatic; body mass index; knee; participation; questionnaire; shoulder*

## INTRODUCTION

Kitesurfing is amongst the world's fastest-growing Olympic aquatic sports, and with a global participation of 2.8 million participants, it is becoming a mass sport (1). Participation is increasing at both amateur and professional levels, among both males and females, predominantly between the ages of 18 and 45, but children and adolescent participation is also rapidly growing (1). Kitesurfing has recently been included in the Olympic programs as well. It made its first appearance at the 2018 Youth Olympic Games in Buenos Aires, Argentina and will be included in the 2024 Paris Olympic Games (1).

Kitesurfing is considered a high-risk activity, and the available scientific literature on this sport focuses mainly on acute injuries (2-9). However, available epidemiological data are quickly outdated and do not account for the rapid

evolution of kitesurfing equipment. While scientific studies report the loss of control of the kite as the leading cause of serious injuries (2-4, 9 -12), this occurrence has become rarer thanks to the introduction of the quick release systems at the beginning of the 21st century. Additionally, total-depower kites (widely adopted from 2005 onwards), allow the kiter to eliminate the pull of the kite by merely letting go of the bar (13). Strategies to improve safety and reduce the incidence of acute injuries have been also developed (14-16). For example, since 2019, it has become mandatory to wear a helmet and impact vest during competitions (1). It was implemented in response to many early reports of kitesurfing trauma involved boards recoiling at the kitesurfer by the elastic board leash (12,13). Kitesurfers may also lose control of the kite during flight and suffer cranial trauma when landing back on their board (17) or being thrown

against an obstacle (4). Outside of competition, however, the use of protective equipment has been reported to range from less than 30% among injured North Sea kitesurfers, to 56% of practicing Portuguese kitesurfers (18).

While much has been done to reduce acute injuries, overuse injuries have yet to be described, despite suggestions that overuse injuries may be a significant cause of reduced performance and morbidity in kitesurfing. In recent years, an increase in competition performance has led to the development of professionalism and a general intensification of training. As seen in traditional activities, the protracted repetition of maneuvers during training may lead to a functional overload of the musculoskeletal system. In addition, the high speeds maintained by the kiteboard over the irregular surface of the water exposes the whole body to high levels of vibration, which may produce overuse injuries (9, 19).

The aim of this study is to capture a picture of the burden of overuse injuries in kitesurfing.

Overuse injuries have been defined as traumatic injuries, without a single, identifiable injury responsible for the event, but caused by repeated microtrauma (20). Overuse injuries are probably under-recorded, even in more traditional sports, due to the lack of medical personnel available to examine athletes on a daily basis, the time-loss from sport injury definition, and through the use of retrospective studies (21). For these reasons, we applied to kitesurfing the focused-on-symptoms approach validated by Clarsen *et al*, for the registration of overuse injuries in different sports, including cross-country skiing, volleyball, floorball, road cycling and handball (22).

## METHODS

Participants were recruited through social media with one of the following criteria: having a kitesurfing focus or being linked to an Italian geographic area which is associated with kitesurfing. Each month, participants received an invitation, in Italian, to complete an online survey. The questionnaire collected data regarding injuries of the shoulders, lower back and knees, and whether the injuries were from kitesurfing or another cause. Specifically, four questions (originally in Italian) were asked:

1. have you had any difficulties participating in normal training and competition due to shoulder/low back/knee problems during the past week?
2. To what extent have you reduced your training volume due to shoulder/low back/knee problems during the past week?
3. To what extent have shoulder/low back/knee problems affected your performance during the past week?

4. To what extent have you experienced shoulder/low back/knee pain related to your sport during the past week?

We excluded non-kitesurfing related injuries and separated acute from overuse injuries in the dataset based on telephone interviews by a sports physiotherapist. The self-reported number of hours spent practicing kitesurfing was collected, as was the main kitesurfing discipline each participant engaged in. At the completion of the study, each participant self-reported age, sex and body mass index (BMI, in  $\text{kg}\cdot\text{m}^{-2}$ ). Approval to conduct this study was given by the institutional Ethics Committee of the second author and all participants gave informed consent.

## ANALYSIS

Data were collected electronically and compiled in an MS® EXCEL spreadsheet, then imported into SAS (Statistical Analysis Software, Cary, NC) version 9.4 for analysis. Means are reported with standard deviations and, where data was not normally distributed, medians are reported with interquartile ranges. Relationships between the binary status of having reported an injury or not, and having reported a serious injury or not, were tested for association with BMI using logistic regression (PROC LOGISTIC).

## RESULTS

Forty-three participants (age: range 21-55, mean: 39, SD: 8.9; BMI: range 15-19, mean: 23 SD: 2.8), engaged in three different disciplines (i.e. freestyle, course racing, wave riding), completed 304 questionnaires. Ten (3%) of these questionnaires were completed within a week of completing a previous questionnaire, with a total of 38 person-days of additional coverage, instead of 70 days since a previous questionnaire was completed. Therefore, the total period covered by completed surveys was 2,096 distinct person-days. Of those, 1,807 (86%) were kitesurfing days involving males (6/43 participants were female, 14%). Median time spent kitesurfing during the previous week was 5.5 hours (IQR 2.5-10). The number of person-days associated with reported problems for shoulders, lower back and knees are shown in **table I**.

The number of person-days associated with reduced training volume due to reported problems for shoulders, lower back and knees are shown in **table II**.

The number of person-days associated with affected performance due to reported problems for shoulders, lower back and knees are shown in **table III**.

**Table I.** Number of person-days for each type of participation related to shoulder, lower back and knee problems (n=2,096).

	Participation	Shoulder n (%)	Low Back n (%)	Knee n (%)
Kitesurfing related	Full participation	1,851 (88.3)	1,447 (69.0)	1,481 (70.6)
	Full but with problems	28 (1.3)	490 (23.4)	7 (0.3)
	Reduced participation due to problems	14 (0.7)	56 (2.7)	483 (23.0)
	Cannot participate due to problems	147 (7.1)	0 (0)	56 (2.7)
Not kitesurfing related	Full participation	28 (1.3)	68 (3.2)	35 (1.7)
	Full but with problems	21 (1.0)	21 (1.0)	70 (3)
	Reduced participation due to problems	0 (0)	7 (0.3)	0 (0)
	Cannot participate due to problems	0 (0)	7 (0.3)	0 (0)

**Table II.** Number of person-days for each type of training volume related to shoulder, lower back and knee problems (n=2,096).

	Reduced training volume?	Shoulder n (%)	Low Back n (%)	Knee n (%)
Kitesurfing related	None	1,901 (90.7)	1,685 (80.4)	1,608 (76.7)
	Minor extent	118 (5.6)	253 (12.1)	229 (10.9)
	Moderate extent	21 (1.0)	48 (2.3)	77 (3.7)
	Major extent	0 (0.0)	0 (0.0)	7 (0.3)
	Cannot participate due to problems	0 (0.0)	7 (0.3)	21 (1.1)
Not kitesurfing related	None	49 (2.3)	89 (4.2)	107 (5.1)
	Minor extent	0 (0)	0 (0)	47 (2.2)
	Moderate extent	0 (0)	0 (0)	0 (0)
	Major extent	0 (0)	14 (0.7)	0 (0)
	Cannot participate due to problems	0 (0)	0 (0)	0 (0)

**Table III.** Number of person-days for each type of affected performance related to shoulder, lower back and knee problems (n=2,096).

	Affected performance	Shoulder n (%)	Low Back n (%)	Knee n (%)
Kitesurfing related	None	1,824 (87.0)	1,538 (73.4)	1,552 (76.7)
	Minor extent	167 (8.0)	365 (17.4)	258 (10.9)
	Moderate extent	49 (2.3)	83 (4.0)	104 (3.7)
	Major extent	0 (0)	7 (0.3)	7 (0.3)
	Cannot participate due to problems	7 (0.3)	0 (0.0)	21 (1.1)
Not kitesurfing related	None	35 (1.7)	75 (3.6)	98 (4.7)
	Minor extent	14 (0.7)	14 (0.7)	56 (2.7)
	Moderate extent	0 (0)	0 (0)	0 (0)
	Major extent	0 (0)	7 (0.3)	0 (0)
	Cannot participate due to problems	0 (0)	7 (0.3)	0 (0)

The number of person-days associated with pain due to reported problems for shoulders, lower back and knees are shown in **table IV**.

Body Mass Index was not significantly associated with reported problems ( $p=0.11$ ). There were 42 individual kite-

surfing styles described by 42 individual participants, which are listed in **Appendix 1**.

During the study, five acute injuries, including one shoulder dislocation and four contusions, were recorded. In 20 overuse injuries, it was possible to apply the Orchard

**Table IV.** Number of person-days for each type of pain related to shoulder, lower back and knee problems (n=2,096).

	Pain	Shoulder n (%)	Low Back n (%)	Knee n (%)
Kitesurfing related	No pain	1,795 (85.6)	1,391 (66.4)	1,461 (69.7)
	Mild pain	189 (9.0)	504 (24.0)	369 (10.9)
	Moderate pain	56 (2.7)	91 (4.3)	84 (17.6)
	Severe pain	7 (0.3)	7 (0.3)	28 (1.3)
Not kitesurfing related	No pain	28 (1.3)	61 (2.9)	35 (1.7)
	Mild pain	21 (1.0)	14 (0.7)	63 (3.0)
	Moderate pain	0 (0)	28 (1.3)	7 (0.3)
	Severe pain	0 (0)	0 (0)	0 (0)

Sports Injury Classification System OSICS10; they included: shoulder muscle strain (4), knee subluxation, biceps tendon lesion, patellar tendinopathy, pain post PCL reconstruction, pain post ACL reconstruction, lumbar pain not otherwise specified (5), Patellofemoral impingement (2), Piriformis syndrome (2), pain post shoulder surgery, ilio-tibial band syndrome.

## DISCUSSION

Participants in this study were predominantly male, coherently with existing literature (23). The problem occurrence during the survey period was not associated with BMI. Since the p-value for the association between BMI and reporting any problem at all was 0.11, the limiting issue may have been the sample size. Further research may clarify the relationship between BMI and the probability of experiencing problems due to injury.

Articular pain related to the practice of kitesurfing was commonly reported. In particular, knee pain was reported in 30% of person-days, low back pain in 29% and shoulder pain in 12%. Overuse symptoms also affected sport participation in terms of quantity; person-days of reduced participation related to shoulder, lower back and knee problems were 8 %, 3% and 8 % of the total respectively and quality performance was affected related to shoulder, lower back and knee problems in 11%, 22% and 16% of person-days respectively.

Knee injuries, which are reportedly among the most common in acute injuries (9-24), also accounted for the greatest number and most disabling of overuse injuries, both in terms of reduction of training volume and performance quality. Knee overuse injuries may be prevalent due to the primarily isometric nature of effort required in kiteboarding and exacerbated by absorbed vibrations, repetitive micro-trauma and overload during landing from jumps, when the legs bend and absorb part of the impact (13,25,26).

In kitesurfing, low back pain may be caused by the stance on the board. This is because the traction of the kite on the waist keeps the lumbar spine in hyperextension, while extreme loads in compression and bending may expose kitesurfers to overuse injuries (13, 16). Vibration might also play an important role. Literature suggests that the daily amount of vibration to which kitesurfers are exposed exceeds the limits suggested by current EU legislation (19, 28).

The strain on shoulders is relevant only during unhooked maneuvers, when the kiter unhooks the kite from the harness, while remaining temporarily attached to the kite by gripping the bar (10). Unhooked freestyle maneuvers, however, are performed at high speed and often lead to severe acute injuries (i.e. shoulder dislocation) rather than to overuse injuries (9). On the contrary, with the kite normally attached to the harness, musculoskeletal demands placed upon the shoulders are limited, and overuse injuries to the shoulder are less likely than to other anatomic regions (13).

To study overuse injuries in sport is difficult in general (21) but may be even more challenging in kitesurfing. As with most action sports, kitesurfing is an intermittent activity, practiced in specific locations, only when the speed and direction of the wind are appropriate. Exercise programs between kitesurfing periods may assist either prevent injuries or reduce their severity (5,24).

## LIMITATIONS

In this study, information is based on self-reported data by athletes, and we cannot exclude that normal symptoms related to sport participation, such as delayed-onset muscle soreness, were confused for overuse injuries. Further limitation is the level of detail collected with the adopted focused-on-symptoms method being limited, and in most cases, the underlying diagnosis was not known. The adoption of telephone interviews by medical personnel was an attempt to

partially overcome these limitations, and in some cases, was able to suggest a possible diagnosis.

In addition, this study was limited to the three predefined injury areas of knees, shoulders and lower back, but it is possible that different body parts are commonly affected by overuse injuries, as have been reported in acute injuries (2,8, 18, 27). In this respect, it may be important to investigate, with the same approach, other articulations (for instance the elbow and the ankle) in order to define in which body areas overuse injuries most commonly occur.

Because each question in the survey investigated if an event had occurred during the previous week, and the responses were binary, it is possible that each type of reported injury may have occurred more than once, and the results in this study may underestimate the number of injuries. It is also unknown what day within the previous week an injury occurred. Therefore, assuming a consequence of seven person-days per injury may overestimate the deleterious effect of reported injuries. Furthermore, participants only had the option of reporting a kitesurfing injury or a non-kitesurfing injury in any week, and the instrument

assumes participants would prioritise reporting kitesurfing injuries over non-kitesurfing injuries, if both occurred within the same survey period.

## CONCLUSIONS

Overuse injuries emerged as an important cause of reduced participation, damaged performance and discomfort in kitesurfing. The method adopted in this study proved to be adequate to capture the burden of overuse injuries, even in an intermittent action sport such as kitesurfing. Knee overuse symptoms and acute injuries are common, as well as lower back symptoms related to overuse. Epidemiological data reported in this paper are important to underpin the creation of specific training programs to prevent injuries and improve comfort and performance in this sport (5).

## CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests (29).

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