Open Access Journal of Sports Medicine

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ORIGINAL RESEARCH

Sports Injuries While Wingfoiling

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Purpose: Wingfoiling is a new popular water sport. Data on the risk of injury or overuse injuries are not yet available. The aim of the study was to analyze the incidence, mechanisms and risk factors for wingfoiling related injuries and the acceptance of safety equipment.

Patients and Methods: Data for this retrospective study were collected through an online standardized questionnaire. It was accessible from January 2022 to June 2022. Information on demographics, injury history, overuse complaints, use of (safety)equipment and fitness routines over the past 12 months were asked.

Results: A total of 415 completed the questionnaire in full and could be included in the study. Fourteen percent (n = 59) were female, 86% (n = 356) were male. The average age was 43.5 years. Fourteen percent (n = 59) participated in competitions. Thirty-one percent (n = 129) of all participants suffered at least one injury in the past 12 months out of a total of 356 injuries. This corresponds to an injury incidence of 5.7/1000h. Typical mechanism of injury was contact with the own sports equipment. The most frequent cause was individual riding errors due to fatigue with 77.5% (n = 276). The most common acute injury types were contusions, strains, cuts and abrasions of the lower extremities. In the case of chronic complaints (n = 173), the shoulder and knee joint were mainly affected. Seventy-three percent (n = 304) of the participants regularly used a protective equipment, such as a helmet or impactvest.

Conclusion: The injury rate of wingfoiling is comparable to windsurfing and kitesurfing. The majority of injuries are minor injuries to the lower extremities. In case of serious injuries, it is mainly the bony thorax that is affected. Most participants already use protective equipment. Overuse complaints mostly affect the large joints.

Keywords: water sports, injury, training, epidemiology

Introduction

Wingfoiling is a popular new watersport, which has already reached the sales figures of kitesurfing within a few years (according to the data of the *Global Wingsports Association* and *Global Kitesports Association*). The development of this new sport began in the 1980s with the construction of the first wing prototypes made from windsurfing sails. But it was only through the use of inflatable wings (like kites in kitesurfing) and the combination of hydrofoils that made the sport more attractive in recent years. In this short time, different wingfoil disciplines have already developed. Thus, similar to windsurfing, it is possible to "foil" on a lake, the open sea or in surf waves. In addition, jumps and acrobatic tricks can be performed (so-called "freestyle", "big air") (Figures 1 and 2).

There are international competitions and numerous athletes who practice this sport very ambitiously.

The basic principle of this sport is that the athlete stands on a surfboard and is propelled by a wing-like sail (called "wing") held with the hands. Above a certain speed, a hydrofoil, mounted under the board, generates so much lift that the board with the athlete is lifted out of the water and flies over the surface of the water with almost no resistance. Even though the sport is gaining popularity, there are no data to be found on the number of wingfoilers. So far, medical literature provides no data on injury epidemiology. There are also no scientific data on the acceptance and usage of safety equipment (like helmet, impactvest, …).

Received: 17 June 2023
Accepted: 18 October 2023
Published: 27 October 2023

Figure 1 Athlete wingfoiling in flat water.

Figure 2 Athlete performing a trick.

Thus, the primary purpose of this study was to investigate the epidemiology of wingfoil-related injuries and corresponding risk factors in a large and heterogeneous group of athletes to provide objective data for physicians, officials and athletes. In addition, we wanted to find out whether there are any physical complaints resulting from the sporting activity that are not due to an acute trauma. Further, we planned to compare these results with windsurfing and kitesurfing, where there are already numerous studies. Another question was whether participants who do regular physical training are less prone to injury.

Finally, the survey aimed to gather data on the usage and acceptance of safety equipment.

Materials and Methods

An online survey was developed (in German, English and French) by means of a professional survey platform (LimeSurvey). Before starting the survey, all participants provided informed consent for participation in this study and confirmed to have taken note of the information on data protection and agreed to the anonymous storage and processing of their data, as well as publication of the results in summarized form. The study protocol was approved by the Ethical Review Board of the Medical University of Witten/Herdecke.

Design

The survey consisted of 6 sections:

1. demographics: age, sex, height, weight, country
2. intensity and frequency of wingfoiling: years of experience, main reasons for practicing this sport, how participant got introduced to the sport, previous water sports experience, preferred spot condition and participation in competitions
3. sports equipment and sports specific safety equipment
4. injuries: performance of warm-up, sports specific training, injuries during the past 12 months, affected body part, type and severity of injury, mode and circumstances of injury, medical therapy
5. overuse injuries: injuries during the past 12 months, affected body part, type and severity of injury
6. free commentaries

Participants and Distribution of Survey

The survey was pilot tested by three experienced wingsurfers to ensure practicability and relevance of included questions. Any person who performed wingfoiling over the past 12 months was allowed to take part in the survey being online from January 2022 until June 2022. The survey was distributed on different social media platforms and wingfoil-related online newsletters and magazines in German, English and French. Athletes who did not sustain any injury were also asked to take part in the survey.

Injury Definitions

Injuries were indicated by the athletes themselves. To estimate the severity of the injuries, questions such as "need to see a doctor or physiotherapist", what kind of therapy was needed and time to return to sports after injury were asked.

Data Analysis

Data were analyzed using Microsoft Excel 16.16.27 and IBM SPSS Statistics 28.0.

Variables were summarized using frequencies and descriptive statistics. Chi square tests were used for statistical comparisons. An alpha level of 0.05 was considered to be statistically significant.

All calculations were based on participants' reports. Age, height and weight were calculated in total and separately for male and female, indicating means, maximum and minimum. The BMI was calculated by dividing participants' weight by height in metres squared.

Preferred wingfoiling-locations (lake, sea, wave), years of wingfoiling experience and skills (self-assessment as "beginner", "advanced" (wingfoiling with tack and jibe) and "expert" (jumps, freestyle-tricks)) were asked. Previous experience in other surfing sports (windsurfing, kitesurfing, stand-up-paddling, surfing), main sporting motivation and the compilation of the wingfoil-sports equipment could be answered by multiple options per question. In addition, sport-specific physical training, warming up immediately before wingfoiling and the participation in competitions were surveyed.

Number of injuries in the past twelve months, injury mechanism, location (on the beach/in the water), time of injury (at the beginning of the session/after one hour/after two hours/later), injured body part and type of injuries could be answered and frequencies were calculated. The participants were asked about the number and duration of wingfoiling-sessions per month and per year in order to calculate the incidence of injury. For athletes who had been practicing the sport for less than one year at that time, the data were extrapolated to one year or not included (two separate calculations were made). Finally, participants were grouped by sex, wingfoiling-location, wingfoiling-skills, performing warm-ups, fitness-routines, participation in competitions and the use of sports specific safety equipment. For each group, the percentage of injured athletes was calculated.

The same procedure was carried out to evaluate the overuse injuries.

Results

Participation Demographics

A total of 553 participants took part in the survey. A total of 415 completed the questionnaire in full and could be included in the study. Two hundred and six participants were from Germany, 125 from France (+ overseas territories), 16 from Austria, 8 from the USA, 7 from the Netherlands, 5 from Switzerland, 5 from Denmark, 4 from Sweden, 4 from South Africa, 4 from the UK and 31 from other countries.

Fourteen percent (n = 59) were female, and 86% (n = 356) were male. The overall average age was 43.5 (min. 9, max. 78) years. The female participants were on average 41.7 years old, weighed 59.8 kg and were 168.6 cm tall, which corresponds to an average BMI of 21.2. The male participants were on average 43.8 years old, weighed 78.5 kg and were 180 cm tall, which corresponds to an average BMI of 24.2. (A BMI of 18.5–24.9 is defined as "normal" weight) (Table 1).

Thirty-six percent (n = 148) participants practiced the sport less than one year, 43% (n = 179) one to two years, 16% (n = 67) two to three years, 5% (n = 21) more than three years. Twenty-five percent (n = 103) assessed their wingfoiling skills as beginner, 55% (n = 228) as advanced and 20% (n = 84) as expert.

Almost all participants (97% (n = 401)) had previous experience from other surfing sports: windsurfing/windfoiling 71% (n = 285), kitesurfing/kitefoiling 52% (n = 210), SUP/SUP foiling 55% (n = 222), surfing 49% (n = 198). The majority taught themselves to wingfoil on their own or together with a friend (85.3% (n = 354)), only 14.7% (n = 61) took part in a course.

Fifty-four percent (n = 225) of the athletes practised wingfoiling on the sea, 12% (n = 48) mainly in the surf waves and 33% (n = 138) on lakes and 1% (n = 4) somewhere else.

Fourteen percent (n = 59) took part in competitions (disciplines: race, freestyle, wave, big air).

Fitness and Warm-Up Routines

Most of the wingfoilers (52% (n = 217)) never warmed up before the sport, some (33% (n = 137)) occasionally and only (15% (n = 61)) regularly. Here, there was no clear age difference between the groups (warm-up: mean age of 47.6 years, no warm-up: 43.2 years). Sixty-three percent (n = 262) did additional physical training for wingfoiling (strength, endurance and /or balance). Among athletes who competed, only 10% warmed up, but 71% did additional physical training.

Incidence of Injuries

Injuries were classified as either acute/traumatic or overuse-related. A traumatic injury was defined as a physical damage caused by an external force (associated with a known trauma), whereas overuse complaints were injuries without a known trauma and with a gradual onset. This definition was explained to the participants in the survey.

Thirty-one percent (n = 129) suffered at least one traumatic injury in the last 12 months in connection with the practice of sport, out of a total of 356 injuries. This corresponds to an injury incidence of 5.7/1000h (Seasonal incidence of 0.86 injuries per wingfoiler/year). When participants, who practiced the sport for less than one year were excluded, the incidence of injury was 5.3/1000h. Athletes, who competed, suffered relatively fewer injuries than those who did not (18.6% <-> 33.1%) with an incidence of 5.01/1000h. Among the beginners, the injury rate was 37.%, among the advanced 34.6% and among the experts 22.6%.

There is a significant correlation between the level of experience and the injury of the athletes (linear by linear association, p = 0.026). With increasing wingfoiling experience, the injury rate decreases.

Table 1 Anthropometric Data

	Total (415)	**Women (59)**	**Men (356)**
Age	43 ± 12.7 (9–78) Y	42 ± 13.4 (9–65) Y	44 ± 12.6 (12–78) Y
Height	178 ± 8.5 (140–208) cm	169 ± 6.6 (140–184) cm	180 ± 7.6 (150–208) cm
Weight	76 ±13.0 (60–117) kg	60 ± 7.7 (32–78) kg	78 ± 11.8 (30–117) kg

Twenty-four percent of the respondents injured themselves within the first hour on the water, 55% in the second hour and 21% later.

Overall, 37.3% (n = 22) of female athletes and 30.1% (n = 107) of male athletes were injured, which did not differ significantly (p = 0.266). But the athletes, who were injured are significantly older than those, who were not injured (*t*-test for equality of means, p = 0.013).

Warming up before wingfoiling or additional physical training also had no significant effect on the risk of injury in our study (p = 0.609, p = 0.592). Participants with previous experience in other surfing sports were not less likely to injure themselves than inexperienced ones (p = 0.242).

Mechanism, Localization and Type of Injury

The most common mechanism of injury was contact with one's own sports equipment (foil/mast 25.9% (n = 92), board 20.2% (n = 72) and wing 7.0% (n = 25)), almost all of which occurred on the water 99.15% (n = 353). Not a single injury occurred due to contact with another water athlete (Figure 3). The most frequent cause were individual riding errors when foiling straight ahead or performing a trick, due to fatigue, with 77.5% (n = 276). The wingfoiling location had no significant influence on the injury rate (Figure 4).

These injuries occurred mainly during leisure time and training. No injuries were reported during competitions.

The most frequent injury types were contusions, followed by joint sprains, cuts, abrasions, lacerations and fractures (Table 2, Figure 5). The most commonly injured regions were the foot, followed by the lower leg, knee and thorax (Table 2, Figures 6 and 7). Six percent (n = 3) of knee injuries and 24% (n = 6) of ankle injuries were caused by the athlete getting caught in the foot straps during the fall.

Of all injured participants, 32% consulted a doctor and 25% a physiotherapist. Fifty percent of the athletes did not require any further therapy after the injuries. Forty-one percent stated that conservative therapies were carried out and 9% of the participants had to undergo surgery. For 40% of the injured, the complaints lasted only a few days, for 35% several weeks, for 16% several months and 9% reported ongoing complaints. These were mainly shoulder dislocations, rotator cuff tears and herniated discs.

Protective Equipment

Far more than half of the participants (80.24% (n = 333)) regularly use some kind of protective equipment: helmets are worn most often (91.3% (n = 304)), followed by impact vests (71.17% (n = 237)), earplugs (17.11% (n = 57)) and wetsuit boots (6.6% (n = 22)). Despite the use of helmets and impact vests, there was no significant difference in head- and thoracic injuries compared to the unprotected athletes (head: p = 0.763, surfer's ear and inflammations were excluded; thorax: p = 0.881).

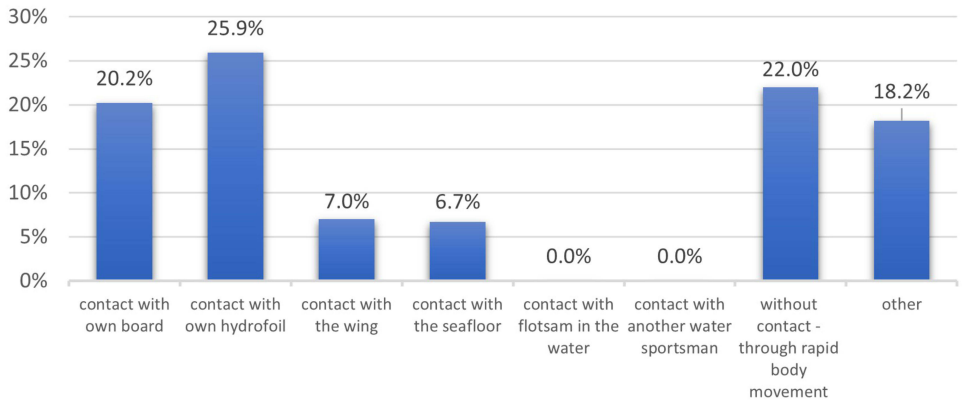

Figure 3 Mechanism of injury.

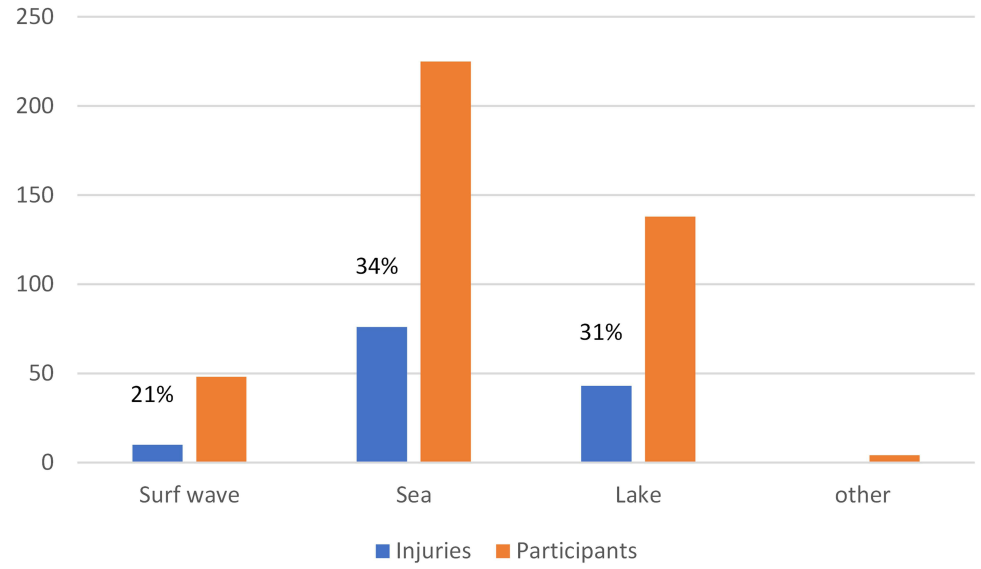

Figure 4 Wingfoiling location an injuries (absolute and relative numbers).

Overuse Injuries

Forty-two percent (n = 173) reported recurring physical complaints without direct trauma. Joints (55%) and muscles (49%) were most affected, with the shoulder girdle, the upper arm/elbow and the thigh/knee being the most common. There was a trend towards more complaints of overuse among male participants and athletes taking part in competitions, but this was not statistically significant.

Discussion

According to our knowledge, this is the first study on wingfoiling injuries so far. A strength of this study is that the sample consisted of a relatively large group of athletes (with, according to our personal experience, a realistic distribution of men and women that provides a typical representation of this sport). However, there are some methodological limitations. First, the outcome measures were self-reported rather than by a more valid approach such as getting data from medical records. There was some degree of recall bias, consequently affecting the validity of results regarding injury history. Second, selection bias is also a concern, and injured athletes could have been more likely to participate in the survey compared to uninjured athletes. Therefore, it is difficult to assess whether injuries are underestimated or overestimated.

Wingfoiling is the latest surfing sport that uses the wind for propulsion. The aim of the study was to present the typical injuries, overuse complaints and risk factors. Compared to the popular sports kitesurfing and windsurfing, the types of acute injuries are similar in these three sports. The majority of injuries are soft tissue injuries of the lower extremities, especially the knee or lower leg, with the ankle/foot most often involved.[1] Overall, the incidence of injury in kitesurfing is highest at up to 10.5/1000h with potentially the most severe injuries. The reasons for this are certainly the high jumps in often very shallow water and the many accidents on the beach/shore when launching and landing the kite.[2–5]

Our study showed a comparable injury incidence of 5.1–5.7/1000h to 5.2/1000h for windsurfing.[6,7] For the incidence of injuries, we could only rely on the information provided by the participants. The duration of wingfoil-sessions is very individual, compared to club sports, where training or competition durations are predetermined. This incomplete coverage of the exact exposure leads to a certain bias.

These three sports are also similar in terms of chronic complaints: the shoulder and the knee joint with the surrounding musculature are mainly affected. In contrast to windsurfing and kitesurfing, no participant in our survey reported persistent back pain from wingfoiling.[6,8,9]

Table 2 Self-Reported Acute Injuries/Complaints

	Strain	Dislocation	Abrasion	Cut	Laceration	Bruise	Fracture	Surfer's Ear	Concussion	Herniated Disc	Capsular Ligament Injury	Tooth Injury	Inflammation	Nail Injury	Total
Eye			1	1	1	1							1		5
Ear				1				3							4
Head			4	3			2		1			2			12
Neck	7					3				1					11
Shoulder	12	5				7									24
Upper arm	5		2			1									8
Elbow	7	1	2	1	1	2									14
Forearm	1		1	2	1	2									7
Wrist	3	1	1		1		1								7
Hand/Finger	5	1	2	2	2	4	2								18
Upper back	6				1	4				1					12
Lower back	8		1	2		3				2					16
Thorax	3	1				23	7								34
Hip		1	3		1	1									6
Groin	1					1									2
Buttocks			1	2		4									7
Thighs			3	2	3	11									19
Knee		3	5	3	3	8					16				38
Lower leg			10	14	5	10									39
Ankle joint	13	1	5	5		1									25
Foot/Toes	3	1	9	17	5	6	4							3	48
Total	**75**	**15**	**50**	**55**	**24**	**92**	**16**	**3**	**1**	**3**	**16**	**2**	**1**	**3**	**356**

https://doi.org/10.2147/OAJSM.S423872

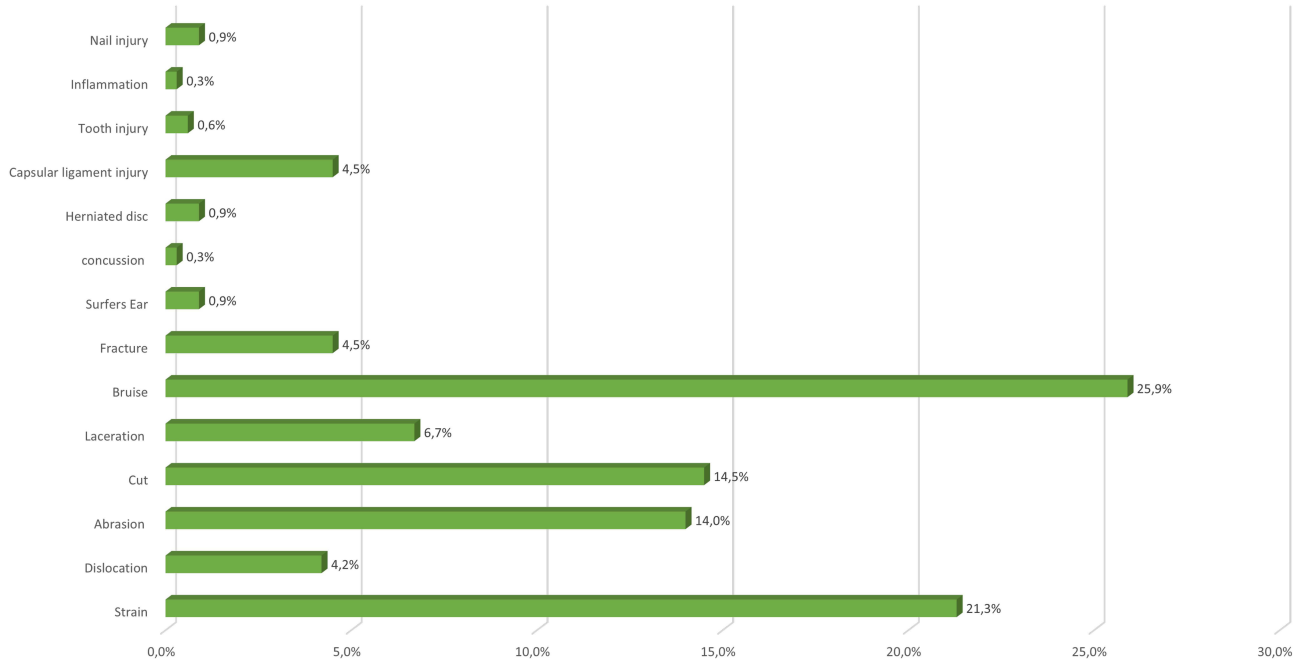

Figure 5 Distribution of injury type.

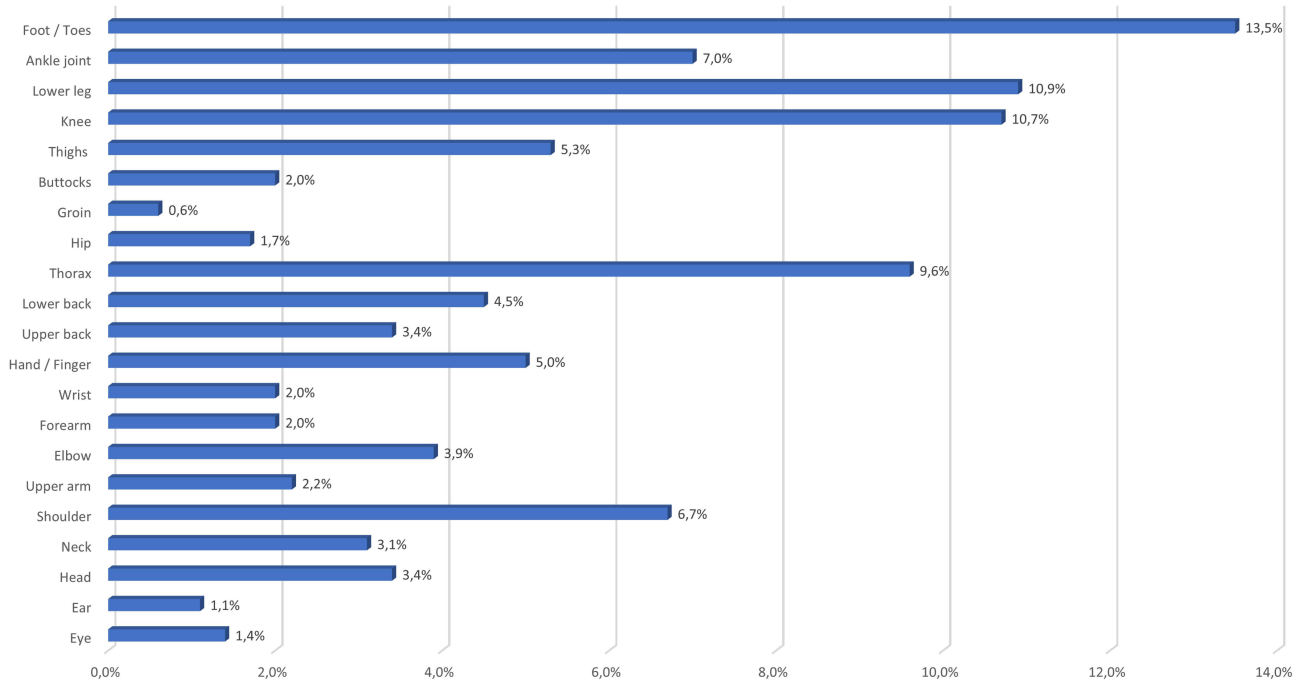

Figure 6 Distribution of injury location.

When it comes to injuries, it is important to distinguish between the different watersports that use hydrofoils. Reports circulating in the press about serious injuries caused by hydrofoils are almost without exception about surfers (foil surfers) who surfed the waves at high risk between other athletes swimming in the water.

The majority of participants in our survey already uses protective gear such as helmets and impact vests on a regular basis. For athletes taking part in official competitions, helmets are mandatory and protective vests are recommended (https://www.wingfoilworldtour.com/wingfoil-race-class/equipment/).

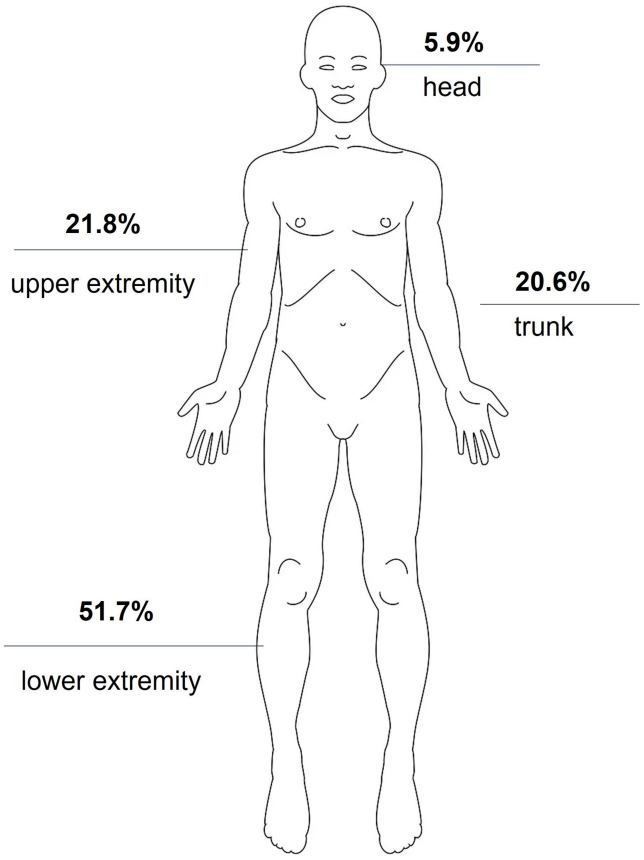

Figure 7 Percentage distribution of injuries.

On the one hand, these "professionals" equipped in this way thus have a role model function. On the other hand, beginners are already equipped with helmet and vest in the wingfoil courses, so that habituation takes place from the beginning and it is not perceived as annoying. In our study, we did not find a significant difference in the frequency and severity of head and thoracic injuries among the athletes who wore protective gear, compared to those who surfed unprotected ($p = 0.763/p = 0.881$).

However, there are many other factors involved (age, experience, environmental factors, etc.) that make an exact injury-risk calculation very difficult. And is not the willingness to take risks with protective equipment higher?

Since helmets and impact vests do not interfere with the practice of sports, we see them as useful injury prevention and endorse them (although our study data do not support this).

The analysis of injury mechanisms allows conclusions regarding injury prevention. We saw an increase in injuries after more than one hour of wingfoiling. Since most participants cited fatigue as the reason, a break might help to prevent injuries. Especially beginners should not overestimate themselves, as they additionally have a significantly increased risk of injury compared to advanced athletes.

Footstraps pose a risk of injury in all surf sports. On the one hand, a firm hold is needed to guide the board while riding and jumping, on the other hand, the fixation of the foot in the strap leads to extreme rotational forces in the knee and ankle during a fall. To avoid such injuries, a special foot strap would have to be developed that only (!) opens in the event of a fall.

From our own experience, if one has previous experience from other surfing sports and is thus familiar with the environmental conditions and the handling of a surfboard, this helps to avoid injuries. However, since only 3% of respondents in our survey had no prior experience in surfsports, we cannot confirm this based on our data.

Besides the protective equipment, a well-founded training in wingfoil schools can certainly contribute to the prevention of injuries (eg behavior in case of a fall, avoidance of chronic complaints through the correct body posture, …). Since wingfoil schools are still in process of being established, there is no exchange of experience yet.

By consistently wearing cut-resistant neoprene shoes (regardless of water temperature), the number of superficial foot injuries could already be significantly reduced. In addition, we recommend wearing shin guards to reduce the frequent superficial injuries to the lower legs. This equipment is not yet available for surfers.

Conclusion

The injury rate of wingfoiling is comparable to windsurfing and kitesurfing. Most acute injuries occur through direct contact with one's own sports equipment in the open water. Common injuries are bruises, strains and cuts/abrasions to the lower extremities. In case of rare serious injuries such as fractures, it is mainly the bony thorax (ribs) that is affected. The majority already uses protective equipment, although, according to the data, there is still room for improvement. Overuse complaints mainly affect the shoulder girdle and knee joints. Modifications of riding technique and equipment as well as sport-specific training could reduce these complaints. Future research is needed to evaluate these proposals.

Acknowledgments

The authors would like to thank everyone who helped distribute the survey and all participants.

Disclosure

The authors report no conflicts of interest in this work. The study complies with the Declaration of Helsinki.

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