VIA MEDICA

REVIEW ARTICLE

Disaster and Emergency Medicine Journal
2025, Vol. 10, No. 1, 44–52
DOI: 10.5603/demj.101461

ISSN 2451–4691, e-ISSN 2543–5957

EPIDEMIOLOGY AND RISK FACTORS FOR TRAUMAS IN KITESURFING WITH PARTICULAR REGARD TO HEAD AND SPINE INJURIES — A NARRATIVE REVIEW

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ABSTRACT

Kitesurfing is becoming more and more popular every year and this year it was introduced into the Olympic Games program for the first time. Combining elements of surfing, wakeboarding, and windsurfing, this sport is considered extreme with an injury risk ranging from 5.4 to 10.5 injuries per 1,000 hours of kitesurfing, increasing to 16.6 injuries per 1,000 hours during competitions. Although most injuries in this sport, where a kitesurfer can accelerate to 35–55 knots and jump to heights of 15 meters, are not life-threatening, serious accidents can occur that may have long-term consequences or even be fatal. Head and spine injuries, which represent 2.9–34.0% and 2.0–16.7% of all reported injuries respectively, are particularly concerning due to their potential neurological consequences. Through analysis of the available literature, it was found that injury risk is influenced by multiple factors, including environmental conditions, equipment type, and experience level. Most injuries occur in shallow water or on the beach, often during launching or landing. While modern safety equipment like quick-release systems has significantly reduced certain risks, the increasing popularity of the sport presents new challenges, such as overcrowding of kitesurfing venues. Preventive measures, including mandatory helmet use during competitions, proper training under qualified instructors, physical conditioning, and designated kitesurfing areas, have shown promise in reducing injury risk. The sport's inclusion in the 2024 Olympics may lead to increased participation and potentially more injuries, emphasizing the importance of implementing comprehensive safety measures and continuing injury surveillance.

KEYWORDS: kiteboarding; craniocerebral trauma; spinal injuries; athletic injuries; water sports

Disaster Emerg Med J 2025; 10(1): 44–52

INTRODUCTION

Ever since its development, kitesurfing, also recognized as kiteboarding, has become one of the most popular water sports. Kites were first developed at the turn of the 1970s and 1990s and a first patented inflatable kite appeared in 1984. Kitesurfing became a sport in the mid-to late-1990s. It is believed that around 3.5 million people practise kitesurfing worldwide, however, this number is a mere estimation as many recreational non-registered athletes' data must be calculated based on sales numbers and travel reservations. Other estimations claimed that the number

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Received: 6.07.2024 Accepted: 4.11.2024 Early publication date: 18.11.2024

of participants increased by up to 30% a year [1–3]. Finally, kitesurfing will have its debut as an Olympic Sport in August 2024 in Paris after its successful appearance at the 2018 Youth Olympic Games in Buenos Aires, Argentina [4]. Hence it seems essential to magnify the nature and potential health consequences of this sport.

Kitesurfing draws from surfing, windsurfing, wakeboarding and power kiting. Required equipment includes a large kite with a surface of 5 to 20 m^2, to which an athlete is attached by 4–5 lines and a handlebar connected to the kitesurfer's harness, as well as a small board of 120 to 200 cm with footpads and straps (Fig. 1–3). The kite converts wind energy into a forward motion, allowing for a speed of up to 35–55 knots reached by course race kitesurfers. Athletes may also jump up to 30 metres in distance and up to 15 metres in height. This is especially used by freestyle kitesurfers who perform tricks and spectacular figures in the air. Some prefer a third option given by kiteboarding, which is the wave discipline, similar to traditional surfing [1, 3].

Kitesurfing is considered a high-risk, or even extreme sport [4–6]. Various researchers tried to estimate an injury rate for kitesurfing. It is believed there are 5.4–10.5 injuries per 1,000 hours of kite surfing [1, 6–9]. This number increases for professional athletes: during the competition, there can be as much as 16.6 injuries per 1,000 hours [5, 8]. 12-month injury rate risk was estimated to be 38% [7]. It is not uncommon for kitesurfers to have more than one injury. One study found that 10.6% of kitesurfers had 2–4 injuries over 6 months [8], while another paper claimed that 27% of participants had two accidents, 14% — three accidents and 6% — four accidents during one year [5].

The growing popularity of water sports such as kitesurfing, windsurfing or surfing evokes their high risk of injuries. Some are less dangerous (like skin lesions or other soft tissue acute injuries), but others are more serious and may have long-term consequences. Kitesurfing seems to be particularly risky: Szymski et al. [2] found that kitesurfers had a higher (21%) proportion of severe injuries (fractures, dislocations, ruptures and concussion) than surfers and windsurfers. According to Pikora et al. [5], kitesurfers were more likely to have an injury in the past 12 months (53% of participants) than people performing personal watercraft riding, water skiing or other towed water sport activities, suggesting

FIGURE 1. Kitesurfer. The full figure of the athlete and the kite can be seen in this photo. In the distance, there are multiple other kitesurfers visible, which supports the thesis explained in the Discussion section about how crowding of the kitesurfing areas is becoming a safety issue

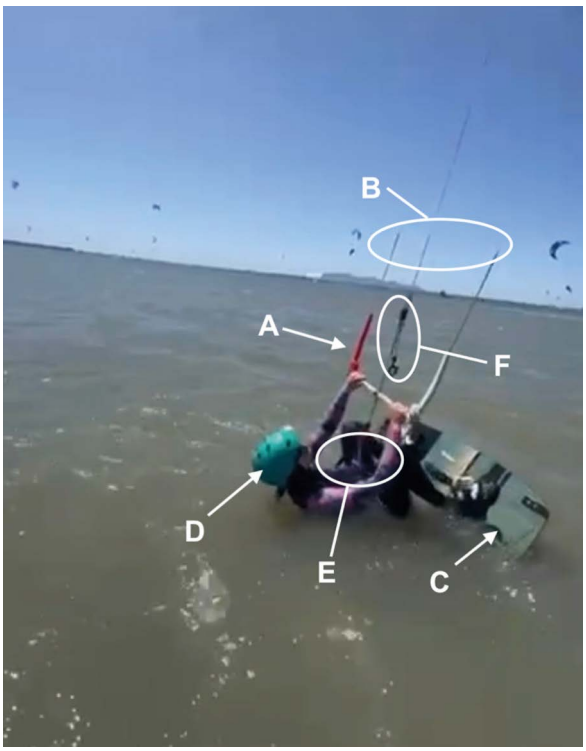

FIGURE 2. Kitesurfing equipment: handlebar (**A**); lines attached to handlebar and kite (**B**); kitesurfing board (**C**); helmet (**D**); quick release system (**E**); depower system (**F**)

FIGURE 3. Example of a trapeze-type belt worn by kitesurfers

that maybe kitesurfing is more hazardous than other water sports.

Which factors contribute to kitesurfing's peril? Past research proved that most injuries happen during jumps and tricks as they are the most hazardous moments in kitesurfing. Other risk factors are high speed, landing on a wave or a chop, a strong blow of wind in the middle of a jump or slipping out of one foot from the strap [7]. Most of these elements are unpredictable and uncontrollable, which makes kitesurfing risks difficult to avoid and strongly contributes to its reputation as an extreme sport.

Another reason for kitesurfing-related trauma is the possible loss of control of the kite during flight, which may lead to landing back on the board or being thrown against an obstacle. These events are particularly prone to cause a cranial injury. Due to possible health risks, since 2019 it has become mandatory to wear a helmet during the competition [4]. However, many recreational kitesurfers do not follow this rule [7].

The US Consumer Product Safety Commission estimated that in 2018 there were 454,407 sports--related head injuries treated at the US hospital emergency rooms [10]. It is also believed that 3.8 million people in the US experience sport and recreation-related concussions each year, with up to half of concussions being unreported since they do not cause loss of consciousness. Concussions may cause cognitive symptoms that can in some cases have long-term impairments [11]. Sports are also the third cause of spinal cord injury and spinal fractures in the US, being associated with high morbidity. These traumas are a leading cause of severe and long-term disability among previously young and healthy individuals and highly constitute a financial burden on healthcare and insurance systems. A study analysing The National Spinal Cord Injury Model Systems Database found that the predominant mechanism in sports-related spinal cord injury was water sports with 959 reported cases [12, 13].

Although kitesurfing injuries can affect various body parts, head and spine injuries are especially severe because of their possibility of serious and lasting consequences. Understanding the prevalence, mechanisms, and severity of these injury types is crucial for developing targeted safety measures and trauma prevention strategies in kitesurfing.

The main goals of this review are to analyse the current literature on the occurrence of injuries in kitesurfing, determine the most frequent types and causes of these injuries among kitesurfers, compare the frequency and seriousness of these injuries in kitesurfing with other extreme water sports, and assess the factors that increase the risk of head and spine injuries in kitesurfing.

MATERIAL AND METHODS

A comprehensive literature search was conducted up to June 2024 to identify relevant studies on the epidemiology of kitesurfing injuries. Electronic databases, including Medline (PubMed), Web of Science and Google Scholar, were searched using appropriate search terms such as "kitesurfing injuries", "kite boarding" and "kitesurfer". Additional relevant articles were identified through manual searching of reference lists of included studies and key review articles.

Studies were eligible for inclusion if they reported original data on head and/or spine injuries related to kitesurfing. Studies were excluded if they were single case reports, the work did not contain statistical data on head and/or spine injuries or did not differentiate between different trauma locations.

Two reviewers independently screened titles and abstracts of identified studies for eligibility. Full texts

of potentially eligible studies were then assessed against the inclusion criteria. Any disagreements were resolved through discussion with a third reviewer.

Data extraction was performed using a standardised form developed for this review. The following information was extracted from each included study: author(s), publication year, study design, sample size, participant characteristics (*e.g.*, age, gender), injury definition, data collection method, injury rates, types of injuries, mechanisms of injury, and risk factors.

Given the heterogeneity in study designs and outcome measures, a narrative synthesis approach was used to summarise the findings.

Quality assessment and risk of bias

The quality of the included research varied significantly, and several possible bias sources have been identified. Recall bias and underreporting of mild injuries may result from the majority of research depending on self-reported injuries. The retrospective character of several studies makes this problem more severe.

Sample sizes vary greatly, from 48 to 626 participants; smaller studies would not have had the statistical power to identify uncommon injury types. Selection bias was a concern in numerous studies that recruited participants through kitesurfing clubs or competitions, potentially overrepresenting more experienced or dedicated participants.

Direct comparisons were difficult since the definition and categorization of injuries varied among studies. While some studies focused primarily on injuries needing medical treatment, others included all reported symptoms. This disparity in the classification of injuries probably adds to the broad range of reported injury rates.

Not many studies accurately estimated how much time kitesurfers spent, using approximations instead. This affects the precision of injury rates calculated per 1,000 hours of activity.

Lastly, it is challenging to say whether observed injury rates are higher than would be expected in the general population or comparable water activities because most studies did not include a control group.

RESULTS

Reviewed studies greatly ranged in sample size, from 48 [14] to 235 [8] respondents. Most subjects in cited works were men with an average age between 27.2 [8] and 34.1 [15] years old. Only in one Portuguese paper, the larger group of participants were women [16]. Average kitesurfing experience ranged between 2.8 [8] and 5 [1] years (Tab. 1) [1, 2, 8, 14–18].

Table 1. Comparison of the sample size, number of all injuries, number of head and spine injuries and injury rates in the reviewed works; sorted by the year of publication

Study [1, 2, 8, 14–18]	Sample size	Total injuries	Total number of head injuries reported	Total number of spine injuries reported	Head Injury Rate (per 1,000 hrs)	Spine Injury Rate (per 1,000 hrs)	Head injury proportion	Spine injury proportion
Nickel et al. (2004)	235	124	17	4	0.96	0.23	13.7%	3.2%
Kwiatkowski et al. (2009)	143	74	2	6	N/A	N/A	3.4%	10.5%
van Bergen et al. (2016)	57	33	11	3	2.38	0.65	34.0%	9.0%
Grunner et al. (2016)	48	48	15	N/A	N/A	N/A	31.3%	N/A
Leeuwerke et al. (2016)	56	78	6	13	N/A	N/A	7.7%	16.7%
van Bergen et al. (2020)	194	177	14	7	0.83	0.42	7.9%	4.0%
Szymski et al. (2021)	626	402	21	8	N/A	N/A	5.2%	2.0%
Silva et al. (2015)	87	73	5	19	N/A	N/A	2.9%	11.2%

In the cited works, head and spine injuries were one of the main causes of injuries while practising kitesurfing. In the study by Nickel et al. [8] skull injuries were 13.7% of all injuries, whereas in Berneira et al.'s [19] work, the total percentage of head and trunk injuries were 20.5%. In the paper by Silva et al. [16], a smaller number of head injuries was noticed (only 2.9%), but a much higher prevalence of lumbar injuries was reported, which reached 11.2% — and was the second most popular cause of injuries in that study. A similar trend is seen in the work of Leeuwerke et al. [15] where head and facial injuries amounted to 7.7% of all injuries and spine injuries were 16.7% of all traumas. In other work by van Bergen et al. [1], the authors describe 7.9% of head injuries and 4% of neck and back injuries among all traumas [1]. Szymski et al. [2] showed a prevalence of 5.2% of head injuries and 2.0% of spine injuries. Grunner et al. [14] found head injuries to be 31.25% of all injuries. In the work of Kwiatkowski et al. [18], a smaller number of head injuries was noticed, with head injuries amounting to only 3.4% of all traumas and spine injuries being 10.5% of cases.

Only some studies described a more precise type of head injury. Nickel et al. [8] reported overall 17 head injuries that included 11 lacerations, 2 contusions with concussion, and 1 contusion with nasal haematoma. Berneira et al. [19] described 3 contusions, 2 swellings, 2 fractures, 2 cuts, 1 dislocation and 2 cases of back pain. However, it should be noted that in this work head and torso injuries were counted together. Leeuwerke et al. [15] mentioned 5 soft tissue injuries and 1 fracture among head injuries, and in the case of spinal injuries: 4 soft tissue injuries and 7 fractures (including 2 with neurological damage without paraplegia). That paper also describes 2 cases of brachial plexus damage. Van Bergen et al. [1] listed 2 fractures among spine injuries and 7 concussions among head injuries. Unfortunately, this work does not specify other types of damage. Kwiatkowski et al. [18] described only two concussions. Szymski et al. [2] stated that the most common injuries were skin lesions. This work detailed a 1.7% concussion occurrence in head injuries. Grunner et al. [14] presented head injuries in more detail, mentioning 2 concussions, 1 subdural haemorrhage (SDH), 1 subarachnoid haemorrhage (SAH), 2 skull fractures, 1 cervical disk herniation, 3 scalp lacerations, 2 lacerations of the lip, 2 lacerations of ears, 1 broken tooth and 1 broken nose. These 2 cases of SAH and SDH were one of the most severe consequences of kitesurfing related to head injuries that were found during the present reviewing process. This paper also reported fatal injuries, as two surfers died because of severe head traumas: skull fractures and intracranial haemorrhage.

DISCUSSION

Different factors impacting the general prevalence of injuries in kitesurfers

Environmental conditions

In Nickel et al.'s [8] study most (54%) reported injuries occurred on water more than 50 metres from the beach, 26% on water closer than 50 metres from the beach and 20% on the beach — the latest type happened mostly during the start of the kite. Van Bergen et al. [1] stated that as much as 91% of injuries took place on the water, with 49.2% in shallow water and 9% being caused by an accident on the shore. This study points out that surprisingly all reported fractures were either sustained in shallow water or on the shore [1]. It was concluded that kitesurfers (especially inexperienced) are particularly at risk during launching and landing the kite on the beach because, in the case of an accident, an athlete will land on the hard surface of the beach and not on the water [17].

Literature reports that injuries occur most often during winds with a force of 3–5 on the Beaufort scale (that corresponds to 7–22 knots) [2, 8, 18], however in the Portuguese study most injuries happened while the wind was stronger: from 17 to 25 knots. Other findings of this study highlighted weather conditions on days of injuries: waves were mostly < 0.5 metres tall (65.8%) or around 0.5 metres tall (17.8%) and most injuries (52.1%) took place during summer [19]. Kwiatkowski et al. [18] reported that 63% of accidents happened during sunny weather with good visibility, whereas meteorological conditions in which one would most likely suspect an accident would be gales, fog, heavy rains *etc*.

However, it can be pointed out that good, summer weather and moderate wind are usually standard conditions in the given water areas and when kitesurfers decide to practise their sport. Yet still 8% of surveyed athletes chose misinterpretation of the weather conditions as the cause of their injury [8].

Equipment and performance type

At the beginning of kitesurfing's popularity, it was broadly reported that the main risk factor in this sport was not being able to fully release oneself from the kite in dangerous situations [6–8]. The most significant step towards safety in this sport was probably the introduction of a quick-release system (QRS) in the early 2000s, which enables the athlete to quickly depower the kite in an emergency. All modern kites use QRS, and the new bow kites depower as soon as the athlete lets go of the bar [7]. Before these changes became an integral part of kitesurfing, a loss of control of the kite with the inability to release the kite from the harness was listed as the main cause of injuries. Too strong gusts of wind carried away the kitesurfers and could hit them against elements of the environment such as stones, moles or boats [6, 8].

For example, in a 2005 South African rescue mission analysis of reasons for calling for aid, 83% of accidents were caused by an inability to detach the kite from the harness. Another 17% were due to injuries like being hit by the board and suffering from fractures, lacerations or contusions. An important element of the pathogenesis was severe exhaustion after being dragged into the open sea by an undetached kite, which led to hypothermia that required treatment in a hospital critical care unit [20]. In 2004 Nickel et al. [8] described one fatal accident during a competition when a 25-year-old female athlete was not able to release her kite and was pulled against a mole after her kite got caught in another competitor's lines. In 2007 Spanjersberg et al. [6] reported a case of a 40-year-old athlete who lost control of his kite after it was caught by a sudden wind on a stormy day. This kitesurfer was walking on the beach toward the waterfront and was thrown against a wooden pole extending above the sand. He suffered from severe deformation of the maxillofacial area which led to an obstructed airway. What is more, the cranium was seriously deformed and both pupils were unresponsive to light and enlarged on the arrival of the rescue team. Due to no breathing nor a palpable pulse this patient was pronounced dead at the site.

In newer works, the authors mention performing tricks and individual mistakes as the main cause of injuries [1, 2, 3, 5]. It should be noted that the most important risk factor for spine fractures is a fall from a height and kitesurfers might jump as high as 15 metres [15]. All cases of head traumas mentioned above justify the campaign to wear helmets as standard kitesurfing safety equipment. In 2004 et Nickel al. [8] reported that only 7% of kitesurfers were wearing a helmet at the moment of the accident. Fortunately, this number increased in more recent studies, with 28% [17] and 40% [7] of kitesurfers admitting to having worn helmets or impact vests. Modern helmets are easy to wear, available at low cost and do not impact the athlete's visual field [14]. Nevertheless, some sportspersons claim that helmets may restrict hearing and when there are several kitesurfers nearby, the ability to hear others is affirmed as a priority [5].

Experience and proper training conditions

Existing literature is not consistent regarding the impact of the experience on injury prevalence. Lundgren et al. [7] found that kitesurfers with less experience (defined as 1–3 years of practice), had significantly more injuries than those from other groups (4–6 and 7–10 years of experience). Interestingly, the beginner group had a lower rate of injury than the total group with only 2.7 injuries per 1,000 hours. One possible explanation is that novice athletes spend more time practising [3]. In contrast, Van Bergen et al. [1] described a decreasing injury rate for athletes with increasing levels of experience. In this study kitesurfers with $<$ 1 year of experience had 17.5 injuries per 1,000 hours, whereas those with 3–5 years of experience had the rate of 11.5. The lowest rate was found for participants with $>$ 10 years of experience, who had an average of 7.8 injuries per 1,000 hours [1]. Notwithstanding, Silva et al. [16] found no statistically significant relationship between having more years of experience and having an injury. These inconsistent results highlight the need for further research recruiting large groups with different experience levels to reliably compare their injury prevalence.

Despite questionable influence on injury statistics, lack of experience is often stated as a subjective reason for sustaining an injury. In one work 15.8% of athletes reported that the lack of experience played a role in their injury [1], in another paper 12.8% of athletes stated that the cause of injury was that they had overestimated their expertise [8]. The greatest impact of this factor was observed by Torland et al. [21], where 100% of kitesurfers chose "operator error/lack of experience" as one of the assumed reasons for the accident.

It would therefore seem reasonable to hypothesise whether a proper course would play a key role in preventing mistakes made by inexperienced kitesurfers, especially since many kitesurfers do not attend such training. For example, in one study 14.9% of participants received no lessons at all [1]. Yet Silva et al. [16] did not find a kitesurfing initiation course to be a differentiation factor for injuries. Moreover, this work denies the impact of warm-up and use of protective equipment on injuries, while these factors were clearly important in other author's research described below. Only enrolment in a physical fitness program was linked to fewer injuries in this Portuguese study. On the other hand, Lundgren et al. [7] found that kitesurfers who claimed they warmed up "sometimes" or "often" had a significantly lower prevalence of injury than those who did not. Bourgois et al. [3] mentioned general and specific physical training combined with other strategies to prevent injuries as important to tolerate forces imposed on the musculoskeletal system. Such strategies could include proprioceptive and core stability exercises, and articular mobilisation. These results might be the most meaningful in light of the growing popularity of kitesurfing, when this discipline is becoming more and more accessible, also to people who are not familiar with other water sports and are less physically fit [1]. In one study 20% of kitesurfers felt that they did not have the adequate level of physical fitness for this sport [19]. Therefore, the knowledge about such training strategies should be more accessible to people willing to try kitesurfing and could eventually decrease the number of injuries, in particular among beginners.

The last factor concerning practice conditions is also linked to the increasing number of kitesurfing enthusiasts, as such popularity may cause crowding of kitesurfing venues, hence increasing the risk of collision accidents [1, 8]. Nickel et al. [8] also suggested that local authorities and communities should assign areas specific for kitesurfing to prevent collisions with surfers, windsurfers and sailors, as a kitesurfer occupies a surface with a much larger radius than a windsurfer; and inexperienced kitesurfers tend to drift off, which may lead to crash accidents.

Head and spine injuries in kitesurfing in comparison with other sports

Comparing injuries during kitesurfing and windsurfing, van Bergen et al. [1] described how amongst kitesurfing traumas, 34% were head and cervical spine injuries and 9% were trunk and thoracolumbar spine injuries. Of windsurfing injuries, 36% were head and cervical spine injuries. Surprisingly, the authors reported no trunk and thoracolumbar spine injuries while practising windsurfing. This greater share of head injuries results presumably from the fact that windsurfers are less likely to wear helmets and also from the greater risk of hitting their heads on sports equipment, hence the bigger risk of head trauma [17]. By contrast, Pikora et al. [5] suggested that kitesurfers suffer from head injuries more often, suggesting that this sport has a higher level of injury hazard or perhaps that kitesurfers are more willing to take risks resulting in traumas.

Other sports connected to using wind force to be in the air and often practised near the beach are paragliding and hang-gliding. Torland et al. [21] mentioned these two disciplines as high-risk sports with common spinal injuries and cerebral concussions. Krüger-Franke et al. [22] described that 45% of all injuries were spinal traumas, of which 14% had neurological complications and 1% ended fatally. This difference may be due to the different altitudes at which the sports are practised, as they fly higher than kite surfers jump.

Publications about wakeboarding, another sport linked to kitesurfing, also report the share of head and spine injuries. Hostetler et al. [23] described that the most traumatic region in wakeboarding is the head and face with respectively 28.8% and 28.4% among all injuries. Regarding the types of injuries, 12.5% of all were traumatic brain injuries. The most popular type of injury was laceration (31.1%) and the most common region for this type of injury was face. Carson's article describes many orthopaedic injuries in wakeboarding, detailing 8 (9.8%) back injuries where more than half were strains. In the section about head injuries there are only 2 lacerations reported [24].

In the article comparing injuries occurring during surfing, kitesurfing and windsurfing Szymski et al. [2] indicated that head injuries were more common in surfing (12.4% of all injuries) than in windsurfing (7.7% of all injuries) and kitesurfing (5.2% of all injuries). Skin lesion was the most common type of head injury, and it was the second most frequent type of injury in surfing (8%). Klick et al.'s [25] work listed 470 head and neck traumas (22.7% of all injuries), with the most frequent being 180 lacerations (38.3%). There were also 56 concussions (11.9%), and 85 internal head injuries (18.5%) including for

example intracranial haematomas. It is suggested that lacerations often occur when a surfer collides with the board or the sea ground [2]. This is similar to kitesurfing where many head injuries, as described above, result from crashing with the obstacles.

Limitations

An important limitation to analysing head and spine injuries in kitesurfing is differences in the details of reported cases. For example, van Bergen et al. [17] only lists the total number of injuries in a given location, Leeuwerke et al. [15] divides these traumas into contusions, soft tissue injuries and fractures, while Nickel et al. [8] adds additional categories, for example, lacerations and swelling. This vast disparity impedes more throughout analysis of these injuries.

What is more, some authors group head injuries with cervical spine injuries. Sometimes it is also not clear when traumas classified as trunk injuries refer solely to spine injuries or those that may have neurological consequences, and when authors thought of muscular or skin conditions.

Reviewed papers often do not mention which environmental or personal risk factors (strong wind, wearing a helmet, doing jumps *etc.*) were true for athletes who experienced specifically head and spine injuries, rather describing them in the context of all reported traumas. This is an important drawback, nevertheless, to the authors' best knowledge, there are currently no articles focusing on this topic.

Finally, Grunner et al. [14] pointed out that there are probably more kitesurfing-related injuries than estimated, but tracking their prevalence in emergency departments is not possible due to a lack of specific ICD codes. Therefore, most papers are either prospective or questionnaire studies with limitations due to sample size or bias.

CONCLUSIONS

Kitesurfing is an extreme water sport, considered particularly prone to traumas and the prevalence of various injuries is high, even in comparison with other high-risk water sports. Some of the affected locations are head and trunk, and injuries in these regions are more severe in nature because of potential neurological consequences. Some described injuries like skin lesions are less grave, but there exist reports of severe complications, including skull and spine fractures, brain haemorrhages or even fatal accidents that occurred during kitesurfing practice. Many various factors were studied to determine what meteorological conditions or equipment types that are linked to higher injury prevalence. It seems that kitesurfing is a rather unpredictable and hazardous sport, where traumas can occur even during calm winds. This highlights the need for kitesurfers to always wear protective gear, especially helmets, as head traumas might have severe consequences on the lives of athletes in this young-predominant sport. Some strategic interventions were suggested to lower the risk of injuries, such as warming up, physical training, proprioceptive and core stability exercises, and articular mobilisation. Kitesurfers should be encouraged to train under the supervision of qualified instructors especially when these professionals are skilled in providing first medical aid. It seems reasonable to favour practice in certified kitesurfing schools, in particular when they have a designated, large enough area to prevent collision accidents with other water sports participants. From a public health perspective, the rising popularity of kitesurfing and its inclusion in the Olympic Games in 2024 may lead to increased participation, potentially resulting in more crowding and a greater absolute number of injuries even if rates remain stable. This emphasises the value of preventative actions against injuries and ongoing observation of injury trends. The authors of this review highly encourage further research on this topic with heterogeneous groups of kitesurfers with different levels of expertise to determine which actions play a key role in preventing head and spine traumas in this sport.

Article information and declarations

Author contributions

All authors have contributed equally to the work.

Funding

The authors declare no funding.

Acknowledgments

The authors would like to express their gratitude to Mr Aleksander Żak for providing authentic photos of himself as a kitesurfer and of the kitesurfing equipment.

Conflict of interest

The authors declare no conflict of interest.

Supplementary material

None.

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