



Evidence Summary: Windsurfing

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Evidence synthesis tool

SPORT:	Windsurfing	Target Group:	Recreational and competitive windsurfers	
Injury Mechanisms:	<p>Common Injuries: Muscle strains. Other reported injuries include shoulder dislocations, skin abrasions, sun burns, back injuries, and in rare cases, drowning.</p> <p>Common Mechanisms: Aerial maneuvers (jumping and high falls) and equipment</p>			
Incidence/Prevalence	Risk/Protective Factors	Interventions	Implementation/Evaluation	Resources
<p>Overall Injury Rates</p> <p>In 2006, Dyson et al. studied the incidence of injuries in competitive and recreational windsurfers. Overall, the incidence of injury was reported as 1.5 injuries/person/year.</p> <p>Nathanson and Reinert (1999) reported an injury incidence of 1 injury per 1000 days.</p> <p>An early study of injury in windsurfers (McCormick and Davis, 1988) reported windsurfing injuries at a rate of 0.22 injuries/1,000 participant hours.</p> <p>Another study by van Bergen et al. (2016) reported the rate of injury as 5.2 per 1000 hours of windsurfing.</p> <p>Recreational Injury Rates</p> <p>For recreational windsurfers, the incidence is reported as 1.2 injuries/person/year (Dyson et al., 2006).</p>	<p>No studies were found that examined specific factors associated with windsurfing and injury outcomes. The primary studies reviewed speculate potential risk factors for injury in windsurfing (Kalogeromitros et al., 2002; Dyson et al., 2006):</p> <ol style="list-style-type: none"> 1. Absence of a lifejacket and/or wet suit. 2. Lack of education regarding the sailing venue and local sailing conditions. 3. Rented boards. 4. Surfing alone. 5. Physical fitness (low levels). 6. Use of a board with no foot-straps. 7. Reckless behavior. 8. Inexperienced surfers. 9. Unfamiliarity with basic sailing vessel rules. 	<p>There are currently no evidence-based injury prevention strategies to reduce the burden of injury in windsurfing; however, there are opportunities for prevention based on the type and mechanism of injury occurring in windsurfers.</p> <p>Studies reviewed for this report suggest:</p> <ol style="list-style-type: none"> 1. Mandating trained lifeguards to monitor surfing activity (Kalogeromitros et al., 2002; Feletti 2017). 2. Having accessible life support equipment (Kalogeromitros et al., 2002). 3. Safer surfing equipment (Kalogeromitros et al., 2002; McCormick and Davis, 1988), particularly the boards foot-strap (Hetsroni et al., 2006; Rosenbaum and Dietz, 2002). Possible development of a break-away footstrap may reduce the incidence of lower extremity 	<p>No studies were found that have evaluated implementation/evaluation strategies in this sport.</p>	<p>Websites</p> <p>Department of Health and Human Services, State Government of Victoria: https://www.betterhealth.vic.gov.au/health/healthyliving/windsurfing-preventing-injury</p>

<p>Competitive Injury Rates For wave/slalom windsurfers, the incidence is reported as 2.0 injuries/person/year, and 1.1 injuries/person/year for race board windsurfers (Dyson et al., 2006).</p> <p>Common Types of Injuries in Both Recreational and Competitive Windsurfers In a study by McCormick and Davis (1988), the most common reported injuries included lacerations (29%), jellyfish stings (26%), abrasions (23%), muscle strain (19%), sunburn (10%), contusions (8%), and blisters (8%). A small number of athletes reported ligament sprain (5%), ear infection (4%), knee injury (4%), eye injury (3%), and splinters (1%).</p> <p>Nathanson and Reinert (1999) reported muscle sprains (26%), lacerations (21%), contusions (16%), and fractures (14%) were the most common injuries reported.</p> <p>A study in 2002 by Rosenbaum and Dietz noted the most common types of injuries to be sprains (26.3%), lacerations (21.2%), contusions (16.2%), and fractures (14.2%). Less common occurrences include dislocations, disk herniation's, jellyfish stings, hypothermia,</p>	<p>10. Rough weather conditions; wind gusts (Van Bergen et al., 2016).</p> <p>One study reported that foot-strap fixation on the board (the surfers foot being fixed onto the board with a strap) could increase the risk of injury to the ankle and/or foot by 36.5% (Hetsroni et al., 2006).</p> <p>A book chapter by Feletti (2017) mentioned the risk of polluted waters which exposes windsurfers to health hazards.</p>	<p>ligamentous injuries (Nathanson et al., 1999)</p> <p>4. Supportive and protective clothing/equipment including personal floatation devices, puncture resistant footwear to prevent foot lacerations and injury from marine animals, and facemasks to protect the face and teeth (Dyson et al., 2006), further, recommendations toward wearing booties or shoes (McCormick and Davis, 1988; Rosenbaum and Dietz, 2002).</p> <p>5. Stricter safety legislation including head protection (Dyson et al., 2006), and an efficient emergency medical system (Kalogeromitros et al., 2002).</p> <p>6. Strength and conditioning programs may improve lower body strength and body posture, and improve upper body strength to manage the demands of the sport (Dyson et al., 2006).</p> <p>7. Improved design of windsurfing apparatus may prevent many injuries and requires further study (Nathanson et al., 1999).</p> <p>8. Fins with duller or softer edges and shorter lengths could potential reduce the number of lacerations caused by the fin (Nathanson et al., 1999).</p>		
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<p>near-drowning, and concussions. Furthermore, clinicians reported patients with ankle injuries, Lisfranc dislocation or fracture, tarsometatarsal injuries, or anterior shoulder dislocations sustained during falls; chronic low-back pain from stresses placed on torsos; and skin lacerations and sun damage (Rosenbaum and Dietz, 2002) In a study by Dyson et al. (2006) muscle strain represented the most common injury (35% of all injuries). However, concussion was reported in five of the wave/slalom group and one in the recreational group.</p> <p>Another study by Kristen (2016) reported windsurf athletes showing a rate of 38% lower leg injuries. With cuts and skin lacerations being the dominant injury.</p> <p>A chapter by Feletti (2017) defined most injuries to be lacerations or puncture wounds due to contact with equipment and the sea floor, and sprains or fractures due to the footstraps.</p> <p>Common Injury Regions</p> <p>A study in 2002 reported the most frequently affected body areas of windsurfers are the</p>		<p>9. A possible harness hook that disengages from the harness line at load equal to the sailor's body weight could prevent injuries obtained from being catapulted (Nathanson et al., 1999).</p> <p>10. Applying sunscreen (McCormick and Davis, 1988; Rosenbaum and Dietz, 2002).</p> <p>11. A wet or dry suit, and gloves can decrease many lacerations, abrasions and blisters (Rosenbaum and Dietz, 2002); (Rosenbaum and Dietz, 2002).</p> <p>12. Choosing the appropriate board according to their physical condition and abilities (Kalogeromitros et al., 2002).</p> <p>13. Avoid overpowering winds (Kalogeromitros et al., 2002; Rosenbaum and Dietz, 2002; McCormick and Davis, 1988).</p> <p>14. Warming up prior to engaging in windsurfing (van Bergen et al., 2016).</p> <p>15. Ear protection (Feletti 2017).</p>		
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<p>lower extremities (44.6%), the upper extremities (18.5%), the head and neck (17.8%), the trunk (16%) (Rosenbaum and Dietz, 2002).</p> <p>In 2006, Dyson et al. reported the common area of injury to be the lower body (22.6%) and feet (16.5%).</p> <p>In a study by Van Bergen et al. (2016) the common affected body sites being the head and cervical spine (36%), upper extremity (24%), and the lower extremity (40%). These injuries generally occurred during difficult manoeuvres such as forward and backward loops, or due to unexpected wind gusts. A chapter by Feletti (2017) summarized windsurfing injuries as acute injuries ranging from 69-78% of all injuries with the lower limb being the most commonly affected part of the body.</p>				
<p>Works Cited:</p> <p>Dyson, R., Buchanan, M., Hale, T. (2006). Incidence of sports injuries in elite competitive and recreational windsurfers. <i>British Journal of Sports Medicine</i>, 40, 346-350.</p> <p>McCormick DP, Davis, AL. Injuries in sailboard enthusiasts.(1988). <i>British</i></p>	<p>Works Cited:</p> <p>Dyson, R., Buchanan, M., Hale, T (2006). Incidence of sports injuries in elite competitive and recreational windsurfers. <i>British Journal of Sports Medicine</i>, 40, 346-350.</p> <p>Kalogeromitros, A., Tsangaris, H., Bilalis, D., Karabinis, A. (2002). Severe accidents due to</p>	<p>Works Cited:</p> <p>Dyson, R., Buchanan, M., Hale, T (2006). Incidence of sports injuries in elite competitive and recreational windsurfers. <i>British Journal of Sports Medicine</i>, 40, 346-350.</p> <p>Kalogeromitros, A., Tsangaris, H., Bilalis, D., Karabinis, A. (2002). Severe accidents due to</p>		

<p><i>Journal of Sports Medicine</i>, , 22:95–7.</p> <p>Nathanson AT, Reinert SE. (1999). Windsurfing injuries: results of a paper- and internet-based survey. <i>Wilderness and Environmental Medicine</i>, 10:218–25.</p> <p>Rosenbaum, Daryl A., and Thomas E. Dietz. (2002). Windsurfing injuries: added awareness for diagnosis, treatment, and prevention. <i>Physician and Sportsmedicine</i> 30.5, 15-24.</p> <p>Kristen KH. (2016) Surfing: Board, Wind, Kite. In: Valderrabano V., Easley M. (eds) <i>Foot and Ankle Sports Orthopaedics</i>. Springer.</p> <p>Van Bergen, C. J. A., Commandeur, J. P., Weber, R. I. K., Haverkamp, D., & Breederveld, R. S. (2016). Windsurfing vs kitesurfing: Injuries at the North Sea over a 2-year period. <i>World Journal of Orthopedics</i>, 7(12), 814–820.</p> <p>Feletti F. (2017) Windsurfing Medicine. In: Feletti F. (eds) <i>Extreme Sports Medicine</i>. Springer, Cham</p>	<p>windsurfing in the Aegean Sea. <i>European Journal of Emergency Medicine</i>, 9(2), 149-154.</p> <p>Hetsroni et al. (2006) Extensor digitorum longus tendonitis in windsurfing due to footstrap fixation. <i>Clinical Journal of Sports Medicine</i>, 16, 74-75.</p> <p>Kristen KH. (2016) Surfing: Board, Wind, Kite. In: Valderrabano V., Easley M. (eds) <i>Foot and Ankle Sports Orthopaedics</i>. Springer.</p> <p>Feletti F. (2017) Windsurfing Medicine. In: Feletti F. (eds) <i>Extreme Sports Medicine</i>. Springer, Cham</p>	<p>windsurfing in the Aegean Sea. <i>European Journal of Emergency Medicine</i>, 9(2), 149-154.</p> <p>McCormick DP, Davis, AL. (1988). Injuries in sailboard enthusiasts. <i>British Journal of Sports Medicine</i>, 22:95–7.</p> <p>Nathanson AT, Reinert SE. (1999). Windsurfing injuries: results of a paper- and internet-based survey. <i>Wilderness and Environmental Medicine</i>, 10:218–25.</p> <p>Rosenbaum, Daryl A., and Thomas E. Dietz. (2002). Windsurfing injuries: added awareness for diagnosis, treatment, and prevention. <i>Physician and Sportsmedicine</i>, 30.5, 15-24.</p> <p>Kalogeromitros, A., Tsangaris, H., Bilalis, D., Karabinis, A. (2002). Severe accidents due to windsurfing in the Aegean Sea. <i>European Journal of Emergency Medicine</i>, 9(2), 149-154.</p> <p>Feletti F. (2017) Windsurfing Medicine. In: Feletti F. (eds) <i>Extreme Sports Medicine</i>. Springer, Cham</p> <p>Van Bergen, C. J. A., Commandeur, J. P., Weber, R. I. K., Haverkamp, D., & Breederveld, R. S. (2016). Windsurfing vs kitesurfing:</p>		
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		Injuries at the North Sea over a 2-year period. <i>World Journal of Orthopedics</i> , 7(12), 814–820.		
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Review of Sport Injury Burden, Risk Factors and Prevention

Windsurfing

Windsurfing is a newer sport that has become popular at both the recreational and competitive levels with millions of participants worldwide (Dyson et al., 2006). Despite the increase in popularity of the sport, there is a lack of information on the incidence, risk factors and interventions to reduce the impact of injury in windsurfing.

Incidence and Prevalence

Currently, there is a paucity of literature examining the incidence rates in the sport of windsurfing. The identified studies examining injury rates in windsurfing have used various methodology and study designs that make summarizing the incidence challenging. An early study was carried out to determine the rate of injuries experienced by windsurfers using a questionnaire- interview approach and through reviewing hospital medical records for water sport injuries. An injury rate of 0.22 injuries/1,000 participant hours was reported (McCormick and Davis, 1988). Approximately ten years later, a study by Nathanson and Reinhart (1999) reported injury incidence of 1 injury per 1,000 days of riding was reported. However, injury data are subject to reporting bias in that people with injuries are more likely to fill out a survey than those without injuries; which would falsely increase the calculated injury rate (Nathanson & Reinhart, 1999). Also, it is important to recognize recall bias, as individuals may not remember all injuries sustained while windsurfing and are likely to remember the more severe injuries (Nathanson & Reinhart, 1999). On the other hand, Dyson et al. (2006) studied the incidence of injuries in competitive and recreational windsurfers using a retrospective questionnaire. Overall, the average injury incidence was reported as 1.5 injuries/person/year (Dyson et al., 2006).

More recently, a retrospective study was conducted to analyze windsurfing injuries. Data was collected over a 2-year period for all patients presenting a windsurfing injury at a hospital in the Netherlands. The reported injury rate was 5.2 per 1,000 hours of windsurfing (Van Bergen et al., 2016). It is important to note the change in technique and risky maneuvers sustained while windsurfing which could explain these more recent injury rates (Van Bergen et al., 2016).

Dyson et al. (2006), examined the incidence rate for recreational and competitive windsurfers separately. The incidence rate for recreational windsurfers was reported as 1.2 injuries/person/year, and for the elite wave/slalom windsurfers the incidence rate was reported as 2.0 injuries/person/year and 1.1 injuries/person/year for the elite race board windsurfers. The average injury incidence/person/year in the elite wave/slalom group was almost twice that experienced by the race board group, which could be attributed to the performance of freestyle acrobatic and aerial manoeuvres performed by the wave/slalom group which have been suggested as possible risk factors to injury.

In general, muscle sprains/strains and lacerations are reported to be the most common reported injury type in windsurfing. (McCormick & Davis, 1988; Nathanson & Reinhart, 1999; Rosenbaum & Dietz, 2002; Dyson et al., 2006; Kristen 2016; Feletti 2017). Other common types

of injury that have been reported include: jellyfish stings, abrasions, sunburn, fractures, contusions, blisters, ligament sprain, ear infection, knee injury, eye injury, splinters, dislocations, disk herniation, hypothermia, concussions, ankle injuries, low back pain, puncture wounds (McCormik & Davis, 1988; Nathanson & Reinert, 1999; Rosenbaum & Dietz, 2002; Dyson et al., 2006; Kristen 2016; Feletti 2017).

The lower body including the feet and toes is reported to be the most commonly affected region of the body (Rosenbaum & Dietz, 2002; Dyson et al., 2006; Van Bergen, 2016; Feletti 2017).

Risk and Protective Factors

No studies were found that examined specific factors associated with windsurfing and injury outcomes. The primary studies reviewed that reported the incidence of injury and common mechanisms of injury in windsurfing, speculate potential risk factors for injury in windsurfing (Kalogeromitros et al., 2002; Dyson et al., 2006; Hetsroni et al., 2006; Kristen 2016; Feletti, 2017; Van Bergen et al., 2016):

1. Absence of a lifejacket and/or wet suit.
2. Lack of education regarding the sailing venue and local sailing conditions.
3. Rented boards.
4. Surfing alone.
5. Physical fitness (low levels).
6. Use of a board with no foot-straps.
7. Reckless behavior.
8. Inexperienced surfers.
9. Unfamiliarity with basic sailing vessel rules.
10. Rough weather conditions; wind gusts.
11. Polluted waters.
12. Certain manoeuvres.
13. Poor technique.
14. Poorly maintained or damaged equipment.

One study reported that foot-strap fixation on the board (the surfers foot being fixed onto the board with a strap) could increase the risk of injury to the ankle and/or foot by 36.5% (Hetsroni et al., 2006).

Opportunities for Prevention: Effective Interventions, Cost-Effectiveness, Implementation and Evaluation

There are currently no evidence-based injury prevention strategies to reduce the burden of injury in windsurfing; however, there are opportunities for prevention based on the type and mechanism of injury in this population. It has been suggested that the common mechanisms of injuries seen in windsurfers are predominantly due to the equipment and/or aerial maneuvers

(jumping and high falls) (Van Bergen et al., 2016; Dyson et al., 2006; Kalogeromitros et al., 2002; Feletti 2017; McCormick and Davis, 1988; Rosenbaum and Dietz, 2002). It has been suggested to develop a break-away foot-strap may reduce the incidence of lower extremity ligamentous injuries (Nathanson et al., 1999; Hetsroni et al., 2006; Rosenbaum & Dietz, 2002). Van Bergen et al. (2016) noted that over time, subtle changes to the foot-strap have been made and a designed for easier exit; as well the booms/apparatus are now made smaller (Van Bergen et al., 2016). Supportive and protective clothing/equipment including personal floatation devices, wet or dry suit, ear protection, head protection, puncture resistant footwear/ booties, and facemasks to protect the face and teeth could potentially prevent many lacerations, abrasions, and blisters (Dyson et al., 2006; McCormick and Davis, 1988; Rosenbaum and Dietz, 2002; Feletti 2017). Additionally, applying sunscreen to reduce the chances of sunburn and/or heat stroke should be considered (McCormick and Davis, 1988; Rosenbaum and Dietz, 2002).

Furthermore, it has been suggested that the fins on the board could be made duller or soften edges, and shorter lengths which could reduce the number of lacerations caused by the fin (Nathanson et al., 1999). It has been proposed that a harness hook that disengaged from the harness line at a load equal to the sailor's body weight could prevent injuries obtained from being catapulted (Nathanson et al., 1999). Windsurfers should also be knowledgeable when choosing the appropriate board according to their physical condition and abilities (Kalogeromitros et al., 2002).

Moreover, it has been suggested to warm-up prior to engaging in windsurfing (Van Bergen et al., 2016), and to consider developing strength and conditioning programs that may improve lower body strength and body posture, and to improve upper body strength to manage the demands of the sport (Dyson et al., 2006). However, it is important to keep in mind the nature of the sport in which the implementation of prevention strategies could be difficult in this population.

Overall, studies reviewed for this report suggest mandating trained lifeguards to constantly monitor surfing activity, and having accessible life support equipment which can facilitate early interventions and care in response to windsurfing incidents (Kalogeromitros et al., 2002). As well, stricter safety legislation including weather regulations and an efficient emergency medical system to contribute to the best possible outcome (Kalogeromitros et al., 2002; Dyson et al., 2006).

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