Evidence Summary: Hiking/Mountaineering

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BC INJURY research and prevention unit

The British Columbia Injury Research and Prevention Unit (BCIRPU) was established by the Ministry of Health and the Minister's Injury Prevention Advisory Committee in August 1997. BCIRPU is housed within the Evidence to Innovation research theme at BC Children's Hospital (BCCH) and supported by the Provincial Health Services Authority (PHSA) and the University of British Columbia (UBC). BCIRPU's vision is *to be a leader in the production and transfer of injury prevention knowledge and the integration of evidence-based injury prevention practices into the daily lives of those at risk, those who care for them, and those with a mandate for public health and safety in British Columbia.*

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Evidence synthesis tool

SPORT:	Hiking/ Mountaineering	**Target Group:**	All ages
Injury Mechanisms:	The mean number of injuries sustained by individuals in mountaineering range from 1.2 to 2.8 (Mort & Godden, 2011). Up to 90% of injuries affected the extremities; however, the main cause of injury is reported as being ill-prepared for the terrain or weather conditions (Mort & Godden, 2011).		

Incidence/Prevalence	**Risk Factors**	**Interventions**	**Implementation/Evaluation**	**Resources**
Overall Injury rates have been reported as 6.1 injuries/1000 participant days (95%CI: 1.2-18.7) for mountaineering. Another study reports injuries at a rate of 0.56 injuries/1000 hours, and fatality rates at 0.13/1000 hours). (McIntosh, Campbell, Dow, & Grissom, 2008; Campbell et al., 2015) For backpacking, overall injuries were reported at 4.7/1000 participant days (95%CI: 3.3-6.4), 2/1000 (95%CI: 0.6-5.4) for day hiking in college-aged adults. (McIntosh, Campbell, Dow, & Grissom, 2008; Campbell et al., 2015) **Frostbite** The incidence of frostbite injury is reported as 366 injuries/1000 population per year, representing 26.4% of all cases with hand involvement. Feet are reported	There were no studies found that examined factors associated with increased risk of injury in mountaineering. The follow describes factors thought to increase the severity of injury. **Environmental Factors** In mountaineering, injury severity after a fall was influenced more by the nature of the climbing surface than by fall height. Traveling on mixed terrain (i.e., rock and snow/ice) was particularly hazardous (Mort & Godden, 2011). It is reported that 51.9% of ankle sprains were from scree grounds and 50.0% on a down slope (Lam, Lui, & Chan, 2011). **Perceived Level of Experience** Retrospective data based on search and rescue patients demonstrated that perceived experience level may be a risk factor for injury. Patients who were described as experts were reported in 100% of the climbing incidents, 89% of	There is a lack of evidence supporting interventions that reduce injury in hiking and mountaineering. The following highlight studies examining other outcomes. **Proper Attire** A randomized pilot study using a climate chamber found that wearing a windbreaker jacket and pants, as well as a cap and gloves ensures a significant increase in core and skin temperature (from 35.3 to 36.1 degrees Celsius and from 21.9 to 25.8 degrees Celsius, respectively) (Burtscher et al., 2012). **Pole-Walking** A study in hikers with trekking poles (TP group) and without (NP group) found significantly less DOMS (delayed onset muscle soreness) (p=0.042) in the TP group, 24 hours (p=0.001) and 48 hours	There are no studies that evaluate the implementation of interventions in mountaineering.	There were no hiking or mountaineering specific resources found.

as second in prevalence with 24.1% of those affected (Harirchi, Arvin, Vash, & Zafarmand, 2005). **Medical Complaints** A review of various studies noted that medical complaints from hiking included diarrhea (56%), skin irritation (51%), acute joint pain (36%), sunburn (26%), tick bites (24%), dehydration (24%), and heat exhaustion (5%). Fifty percent of injuries were reported as sprains and strains of knees, ankles, and the back and the most commonly reported mechanism of injury was falls, followed by slips, and overuse factors. Twenty-six percent of injuries involved the lower extremities. Abrasions, lacerations, and contusions were experienced by up to 3 quarters of individuals injured. Up to 90% of injuries affected both upper and lower extremities (Angert & Schaff, 2010). **Search and Rescue** From 10 years of search and rescue data, 53% of hikers reported extremity pain, 11% GI problems, 10% altered mental status, 9% head pain, 4% chest pain, 4% difficulty breathing, 6% fatigue, and 3% severe or fatal injury in mountaineering. Forty-	hiking-scrambling incidents, and 45% of hiking on trail incidents (Boore & Bock, 2013). **Other** One study reported that older age (>21 years of age), being overweight, having a history of ankle sprains, hikers that used poles, and inadequate shoe size and shoe lace tightness increased the odds of ankle sprain (Lam et al., 2011). Another study found a significant relationship between lack of proper equipment or guide, increased the odds of suffering frostbite (OR=14.3, p<0.001) (Harirchi et al., 2005). In lab settings, pole-walking does not reduce the load on lower extremities, yet authors of this work advise bringing poles on a hilly terrain to reduce loading on joints (Jensen et al., 2011) One study; however, found an increase in the odds of ankle sprain in hikers that used poles (Lam et al., 2011).	(*p*=0.0027) after the trek compared to the NP group. There was also a reduced loss of strength immediately after the trek (*p*=0.008), at 24 hours (*p*<0.001) and 48 hours (*p*=0.033) after the trek in the TP group (Howatson et al., 2011). .		

six percent of injuries were reported from hiking on a trail, 11% from scrambling (Boore & Bock, 2013).				
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Review of Sport Injury Burden, Risk Factors and Prevention

Hiking/Mountaineering

Incidence and Prevalence

The overall injury rates for hiking and mountaineering are reported as 6.1 injuries/1000 participant days (95%CI: 1.2-18.7) for mountaineering. Another study reports injuries at a rate of 0.56 injuries/1000 hours, and fatality rates at 0.13/1000 hours. (McIntosh, Campbell, Dow, & Grissom, 2008; Campbell et al., 2015) For backpacking, overall injuries were reported at 4.7/1000 participant days (95%CI: 3.3-6.4), 2/1000 (95%CI: 0.6-5.4) for day hiking in college-aged adults (McIntosh, Campbell, Dow, & Grissom, 2008; Campbell et al., 2015). A review of various studies noted that medical complaints from hiking included diarrhea (56%), skin irritation (51%), acute joint pain (36%), sunburn (26%), tick bites (24%), dehydration (24%), and heat exhaustion (5%). Fifty percent of injuries were reported as sprains and strains of knees, ankles, and the back and the most commonly reported mechanism of injury was falls, followed by slips, and overuse factors. Twenty-six percent of injuries involved the lower extremities. Abrasions, lacerations, and contusions were experienced by up to 3 quarters of individuals injured. Up to 90% of injuries affected both upper and lower extremities (Angert & Schaff, 2010).

The incidence of frostbite injury is reported as 366 injuries/1000 population per year, representing 26.4% of all cases with hand involvement. Feet are reported as second in prevalence with 24.1% of those affected (Harirchi, Arvin, Vash, & Zafarmand, 2005).

From 10 years of search and rescue data, 53% reported extremity pain, 11% GI problems, 10% altered mental status, 9% head pain, 4% chest pain, 4% difficulty breathing, 6% fatigue, and 3% severe or fatal injury in mountaineering. Forty-six percent of injuries were reported from hiking on a trail, 11% from scrambling (Boore & Bock, 2013).

Risk and Protective Factors

There were no studies found that examined factors associated with increased risk of injury in mountaineering. The following describes factors thought to increase the severity of injury.

Environmental Factors

In mountaineering, injury severity after a fall was influenced more by the nature of the climbing surface than by fall height. Traveling on mixed terrain (i.e., rock and snow/ice) was particularly hazardous (Mort & Godden, 2011). It is reported that 51.9% of ankle sprains were from scree grounds and 50.0% on a down slope (Lam, Lui, & Chan, 2011).

Perceived Level of Experience

Retrospective data based on search and rescue patients demonstrated that perceived experience level may be a risk factor for injury. Patients who were described as experts were reported in 100% of the climbing incidents, 89% of hiking-scrambling incidents, and 45% of hiking on trail incidents (Boore & Bock, 2013). In terms of lightning, the "30–30" rule states that there is a danger of being struck when the interval between seeing the lightning and hearing the thunder is less than 30 seconds (flash- to-thunder time) and that one should not continue climbing until 30 min have elapsed after seeing the last lightning and hearing the last thunder (Zafren et al., 2005). The best place to shelter during a lightning storm is in a hut or mountain refuge, away from open doors or windows. If caught in the mountains, stay off ridges and summits and stay away from single trees, power lines and ski lifts (Zafren et al., 2005).

Other

One study reported that older age (>21 years of age), being overweight, having a history of ankle sprains, use of poles, and inadequate shoe size and shoe lace tightness increased odds of ankle sprain (Lam et al., 2011). Another study found a significant relationship between lack of proper equipment or guide, increased the odds of suffering frostbite (OR=14.3, $p<0.001$) (Harirchi et al., 2005). Finally, one lab based study demonstrated that pole-walking does not reduce the load on lower extremities, yet the authors of this work still advise to bring poles on a hilly terrain to reduce loading on joints (Jensen et al., 2011). Another study; however, found an increase in the odds of ankle sprain in hikers that used poles (Lam et al., 2011).

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

There is a lack of evidence supporting interventions that reduce injury in hiking and mountaineering. The following highlight studies examining other outcomes.

Proper Attire

A randomized pilot study using a climate chamber found that wearing a windbreaker jacket and pants, as well as a cap and gloves ensures a significant increase in core and skin temperature (from 35.3 to 36.1 degrees Celsius and from 21.9 to 25.8 degrees Celsius, respectively) (Burtscher et al., 2012).

Pole-Walking

A study in hikers with trekking poles (TP group) and without (NP group) found significantly less DOMS (delayed onset muscle soreness) (p=0.042) in the TP group, 24

hours ($p=0.001$) and 48 hours ($p=0.0027$) after the trek compared to the NP group. There was also a reduced loss of strength immediately after the trek ($p=0.008$), at 24 hours ($p<0.001$) and 48 hours ($p=0.033$) after the trek in the TP group (Howatson et al., 2011).

There are no studies that evaluate the implementation or cost-effectiveness of interventions in mountaineering.

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