ACTIVE & SAFE

Evidence Summary: Rowing

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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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UBC BC Children's Hospital Research Institute

Evidence synthesis tool

SPORT:	Rowing	**Target Group:**	Heavyweight & elite rowers (predominantly female) ~20-26 (collegiate)	
Injury Mechanisms:	**Common Injuries:** Predominantly overuse related: knee, lumbar spine, ribs, upper extremity; stress fractures **Common Mechanisms:** Incorrect technique, volume of training load, type of boat rowed, training (such as weight training) & rowing ergometer, changes in the design and shape of the rowing oar			
Incidence/Prevalence	**Risk/Protective Factors**	**Interventions**	**Implementation/Evaluation**	**Resources**
Overall Injury Rates In 2014, a review by Wilson reported the prevalence of low back pain in rowers ranged from 31.8% to 51% of the cohort. **Elite & Collegiate** In 1997, a study by Kanstrup et al. examined the risk of stress fractures in elite rowers. The prevalence of injury at the international level was 12%. Specifically looking at elite rowers from a national team consisting of 50 male and female rowers, 12% reported previous history of injury (Kanstrup et al., 1997). In 2012, a review was conducted which examined the biomechanics of the rowing stroke and rowing-related injury patterns, it was reported that the rowing athlete may experience low	In 2014 Wilson et al., reviewed ergometer training volume and previous injury in predicting low back pain in rowing; and strategies for injury prevention and rehabilitation. Ergometer training and history of injury are the strongest risk factors. Noting protective factors being properly coached/trained in correct rowing technique that strongly influence the loads placed on the spine; lumbar flexion and extension at either end of the stroke are risk factors. Factors significantly associated with the development of back pain included age (history of rowing before age 16), use of a hatchet oar, training with free weights, weight machines and ergometers, ergometer sessions lasting longer than 30 min. Wilson et al., also found that time spent ergometer training was the most significant predictor of onset of low back pain. Also, 'time of year' was a risk factor with back pain to most likely develop in winter months (39% of cases) compared	There are currently no evidence-based injury prevention strategies to reduce burden of injury in rowing; however, there are opportunities for prevention based on the type and mechanism of injury occurring in rowers (Wilson et al., 2014). Studies reviewed for this report suggest: <u>Elite:</u> 1. Well trained and educated coaches to ensure training correct technique (Wilson et al., 2014); (Yang et al., 2015); (Clay et al., 2016). 2. Addressing modifiable risk factors: training components (ergometer work & prolonged sessions, and recommendations of proper volume of training (Wilson et al., 2014); (Hosea et al., 2012). 3. Screening of rowers to investigate previous injury & assess parameters that influence poor lumbopelvic technique, including hip flexor and hamstring flexibility and the function of muscles around the lumbopelvic	No studies were found that have evaluated implementation/evaluation strategies in this sport.	**Websites** Department of Health and Human Services, State Government of Victoria: https://www.betterhealth.vic.gov.au/health/healthyliving/rowing-preventing-injury

back pain during periods of intense training, the intercollegiate rower has less of a chance of low back pain than that of the general population (51.4% vs. 60-80% respectively) (Hosea et al., 2012). Moreover, Yang et al. (2012) studied the epidemiology of overuse injuries sustained by collegiate athletes and compared the rates of overuse and acute injuries. Yang et al., reported that overall the injury rate for overuse injuries was 30.2 per 10,000 athlete exposures for rowers, and the injury rate for acute injuries was 22.7 per 10,000 athlete exposures; athlete exposure was defined as attending 1 coach-directed session of either a game or practice as reported in SIMS (Sports Injury Monitoring System). **Common Injury Types/Regions** In 1997, Kanstrup et al. noted rib stress fractures to be a common type of injury experienced by rowers. Another review reported on the common types of injuries seen in rowers (Hosea et al., 2012; specifically stress	to the spring (33%), autumn (25%), and summer (4%); which likely reflects the high level of training in the winter. Additionally, the primary studies reviewed speculate potential risk factors for injuries in rowing (Hosea et al., 2012); (Christiansen et al., 1997); (Buckeridge et al., 2015) 1. Type of oar (being shorter than a traditional oar; shape and size of the blade). 2. Volume of training (Hosea et al., 2012). 3. New equipment (rowing ergometers and blades) (Kanstrup et al., 1997). 4. High intensity training levels (Buckeridge et al., 2015). 5. Duration of training (Buckeridge et al., 2015). 6. Type of training (Buckeridge et al., 2015). 7. Previous experience with low back pain in college- more likely to have future episodes of back pain than those rowers who were asymptomatic in college (Hosea et al., 2012).	region (Wilson et al., 2014) 4. Understanding kinematics and kinetics may increase understanding of injury onset (Wilson et al., 2014); a need to consider how to use research findings to steer training programmes in rowers; and understanding mechanics of the lower limb and hip as well as analysis of muscle activity. As it is likely that factors such as knee, hip and ankle joint function will influence loading at the lumbar spine, and a better understanding of this is required (Wilson et al., 2014). 5. Monitoring technique is important and the ability to perform this during ergometer sessions may prove to be invaluable to injury prevention and management (Wilson et al., 2014). 6. Biomechanical analyses have shown that correct rowing technique can have a strong influence on the loads placed on the spine, and thus educating athletes on proper form is vital for performance and injury prevention (Wilson et al., 2017). 7. There is a need to consider endurance of the trunk muscles to facilitate proper lumbopelvic rhythm; factors such as rowing intensity, fatigue, and skill level will also influence trunk control (Wilson et al., 2014). 8. It has also been noted that the		

fractures to the ribs, extensor tenosynovitis of the wrist, discogenic back pain, and chondromalacia patella and iliotibial band friction syndrome. In 1997, Kanstrup et al. reported the ribs to be a common site of injury seen in rowers. In 2014, a review by Wilson et al. noted the low back to be a common region of injury in rowers. Another review reported on the common injury regions seen in rowers (Hosea et al., 2012), predominantly overuse in nature) and they are the knee, lumbar spine (back), upper extremity and ribs.		ergometer exaggerates these changes in technique compared to 'on-water' rowing, and should be considered when developing an injury prevention program for rowers (Wilson et al., 2014).		
Works Cited: Christiansen, E., Kanstrup, I.L. (1997). Increased risk of stress fractures of the ribs in elite rowers. *Scandinavian Journal of Medicine & Sciences in Sports, 7,* 49-52. Hosea, T. M., & Hannafin, J. A. (2012). Rowing Injuries. *Sports Health*, *4*(3), 236–245. Wilson et al. (2014). Ergometer training volume and previous	**Works Cited:** Christiansen, E., Kanstrup, I.L. (1997). Increased risk of stress fractures of the ribs in elite rowers. *Scandinavian Journal of Medicine & Sciences in Sports, 7,* 49-52. Buckeridge et al. (2015). Biomechanical determinants of elite rowing technique and performance. *Scandinavian Journal of Medicine & Sciences in Sports, 25,* 176-183.	**Works Cited:** Yang et al. (2012). Epidemiology of overuse and acute injuries among competitive collegiate athletes. *Journal of Athletic Training, 47*(2), 198-204. Hosea, T. M., & Hannafin, J. A. (2012). Rowing Injuries. *Sports Health*, *4*(3), 236–245. Wilson et al. (2014). Ergometer training volume and previous injury predict back pain in rowing; strategies for injury prevention and rehabilitation. *British*		

injury predict back pain in rowing; strategies for injury prevention and rehabilitation. *British Journal of Sports Medicine, 48* 1534-1537. Yang et al. (2012). Epidemiology of overuse and acute injuries among competitive collegiate athletes. *Journal of Athletic Training, 47*(2), 198-204.	Hosea, T. M., & Hannafin, J. A. (2012). Rowing Injuries. *Sports Health*, *4*(3), 236–245. Wilson et al. (2014). Ergometer training volume and previous injury predict back pain in rowing; strategies for injury prevention and rehabilitation. *British Journal of Sports Medicine, 48* 1534-1537.	*Journal of Sports Medicine, 48* 1534-1537. Clay et al. (2016). Association between rowing injuries and the functional movement screen in female collegiate division I rowers. *The International Journal of Sports Physical Therapy, 11*(3), 345-349.		

Review of Sport Injury Burden, Risk Factors and Prevention

Rowing

Rowing is a one of the original modern Olympic sports and was one of the most popular spectator sports in the United States, with an increase in popularity since the enactment of Title IX (Hosea et al., 2012). The injury patterns in rowing are unique due to the high amount of stress applied during the rowing stroke (Hosea et al., 2012). Despite the increase in popularity of the sport, there is a significant lack of information on the incidence, risk factors, and interventions to reduce the impact of injury in rowing.

Incidence and Prevalence

Currently, there is a paucity of literature examining incidence rates in the sport of rowing. The studies that have examined injury rates in rowing have used various methodology and study designs to gather the data. In 2014, a review by Wilson et al., reported the prevalence of low back pain in rowers of all levels ranged from 31.8% to 51% of the cohort.

Specifically looking at elite rowers from a national team consisting of 50 male and female rowers, 12% reported previous history of injury (Kanstrup et al., 1997). In 2012, a review was conducted which examined the biomechanics of the rowing stroke and rowing-related injury patterns, it was reported that the rowing athlete may experience low back pain during periods of intense training, the intercollegiate rower has less of a chance of low back pain than that of the general population (51.4% vs. 60-80% respectively) (Hosea et al., 2012). Moreover, Yang et al. (2012) studied the epidemiology of overuse injuries sustained by collegiate athletes and compared the rates of overuse and acute injuries. Yang et al., reported that overall the injury rate for overuse injuries was 30.2 per 10,000 athlete exposures for rowers, and the injury rate for acute injuries was 22.7 per 10,000 athlete exposures; athlete exposure was defined as attending 1 coach-directed session of either a game or practice as reported in SIMS (Sports Injury Monitoring System).

Rib stress fractures and low back pain are the most commonly reported injury in rowers (Kanstrup et al., 1997; Hosea et al., 2012; Wilson et al., 2012). Hosea et al., (2012) also noted extensor tenosynovitis of the wrist, discogenic back pain, and chondromalacia patella and iliotibial band friction syndrome as common injury types. Additionally, it has been noted that injuries are predominantly overuse in nature and affect the knee, lumbar spine, and upper extremity most often (Hosea et al., 2012).

Risk and Protective Factors

There is a lack of quality data that examines specific risk factors for injury in rowing. The studies reported here, speculate on potential risk factors.

In 2014, Wilson et al. examined ergometer training volume and previous injury to predict low back pain in rowing; and strategies for injury prevention and rehabilitation. It was found that ergometer training was the most significant predictor/risk factor of low back pain, especially sessions lasting longer than 30 minutes. IN addition, history of injury was also associated with injury in rowing (Wilson et al., 2014). 'Time of year' was also a risk factor for back pain, as rowers were most likely to develop back pain in the winter months (39% of cases) compared to the spring (33%), autumn (25%) and summer (4%); which likely reflects that high level of training in the winter (Wilson et al., 2014). Additional risk factors significantly associated with the development of back pain included age (history of rowing before age 16), use of a hatchet oar, training with free weights, and weight machines (Wilson et al., 2014). Protective factors were noted as being properly coached/trained in correct rowing technique that strongly influence the loads places on the spine; lumbar flexion and extension at either end of the stroke are risk factors (Wilson et al., 2014).

Other studies speculate potential risk factors for injuries in rowing, and they include (Hosea et al., 2012; Christiansen et al., 1997; Buckeridge et al., 2015):

1. Type of oar (being shorter than a traditional oar; shape and size of the blade).
2. Volume of training (Hosea et al., 2012).
3. New equipment (rowing ergometers and blades) (Kanstrup et al., 1997).
4. High intensity training levels (Buckeridge et al., 2015).
5. Duration of training (Buckeridge et al., 2015).
6. Type of training (Buckeridge et al., 2015).
7. Previous experience with low back pain in college- more likely to have future episodes of back pain than those rowers who were asymptomatic in college (Hosea et al., 2012).

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

There are currently no evidence-based injury prevention strategies to reduce to burden of injury in rowing; however, there are opportunities for prevention based on the type and mechanism of injury occurring in rowers. Studies reviewed for this report suggest well-trained and educated coaches to ensure correct technique is taught, and associated recommendations of training volume and regimens (Wilson et al., 2014); (Clay et al., 2016). Likewise, Wilson et al., (2014) noted that monitoring technique is important and the ability to perform this during water as well as ergometer sessions may prove to be invaluable to injury prevention and management. Biomechanical analyses have shown that correct rowing technique can have a strong influence on the loads placed on the spine, and thus educating athletes on proper form is vital for performance and potential injury prevention (Wilson et al., 2014). Screening rowers to investigate previous injury and assess parameters that influence poor lumbopelvic technique including hip flexor and hamstring flexibility and the functions of muscles around the lumbopelvic region (Wilson et al., 2014). Likewise, as for training and rehabilitation, there is a need to consider endurance of the trunk muscles to facilitate proper lumbopelvic rhythm; factors such as rowing intensity, fatigue, and skill level will also influence trunk control (Wilson et al., 2014).

Addressing modifiable factors such as training components including ergometer work and prolonged sessions could also aid in injury prevention in rowers (Hosea et al., 2012). It has also been noted that the ergometer exaggerates these changes in technique compared to 'on-water' rowing, and should be considered when developing an injury prevention program for rowers (Wilson et al., 2014). Recognizing the onset and decreasing the intensity of training may prevent the progression to an acute fracture; primarily rib stress fractures are in abundance during training (Hosea et al., 2012). Prevention of rib stress fractures involves incorporating core and upper-back strengthening exercises as part of the regular training program and avoiding long, high-load ergometer training sessions (Hosea et al., 2012).

Finally, understanding kinematics and kinetics may aid in understanding the onset of injury, specifically understanding the mechanics of the lower limb and hip as it is likely that factors such as knee, hip and ankle joint function will influence loading at the lumbar spine (Wilson et al., 2014). Knowledge of how a rower's body moves during the rowing stroke is needed to understand the mechanisms associated with rowing injuries (Wilson et al., 2014).

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