ACTIVE & SAFE

Evidence Summary:
Yoga

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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:	Yoga	**Target Group:**	All age groups
Injury Mechanisms:	Common Injury Locations: Trunk (back), lower limb (knee), and head (Russell, Gushue, Richmond, & McFaull, 2016; Swain & McGwin, 2016) Common Injury Types: Musculoskeletal (MSK) (strains and sprains), digestive, neurological and respiratory events (Cramer, Ostermann, & Dobos, 2018; Swain & McGwin, 2016) Common Mechanisms: Over-stretching, stumbling into another participant, the surface (e.g. slippery surfaces) and equipment (e.g. tripping over a mat) during yoga pose.(Russell et al., 2016)		

Incidence/Prevalence	**Risk/Protective Factors**	**Interventions**	**Implementation/ Evaluation**	**Resources**
Summary Injury Rate: • 1.45 injuries per 1000h of yoga practice (Mikkonen, et al, 2008) **Incidence of Injury/Adverse Events** The incidence proportion reported differs based on how the data was collected. Results from cross-sectional survey studies have reported higher incidence proportions and a lifetime prevalence of yoga related injuries/ adverse events. • **Incidence proportion (any adverse event):** 22.7% (95%CI: 21.1 to 24.3). This is based on a convenience sample of 2508 yoga practitioners attending a yoga class in 224 locations across Japan • **Lifetime prevalence** (any adverse event) event: 35.4% (95%CI: 31.4 - 39.4%) based on a web-based nationwide survey among US yoga practitioners • **Lifetime prevalence (**meaningful injury/more server injury): 21.3% (95%CI: 19.7-22.9%)	There is limited research examining risk factors for injuries specifically in yoga. Examining some of the injury rate data stratified by potential risk factors can help inform our understanding. **Age** Swain et el. 2016 examined injury rates across 3 age groups and reported that older individuals have a higher rate of injury: Injury rates by age (2014) 18-44: 11.90 per 100 000 participants 35-64: 17.68 per 100 000 participants 65+: 57.91 per 100 000 participants. Another review reported that on average across 9 observational studies, adverse events were more often serious in participants above the age of 70. (Cramer et al., 2018) **Sex** Research examining injury rates stratified by sex is inconsistent. One	No interventions to reduce injury in yoga were found from this review.	No implementation or evaluation studies were found in the literature.	**Websites** **OrthoInfo- Yoga Injury Prevention** https://orthoinfo.aaos.org/en/staying-healthy/yoga-injury-prevention **Ontario Physical Education Safety Guidelines:** Elementary school students (http://safety.ophea.net/safety-plan/168/1856) Secondary school students http://safety.ophea.net/safety-plan/169/1998 **National Center for Complementary and Integrated Health- Scientific Results of Yoga for Health and Well-Being Video** https://nccih.nih.gov/video/yoga

(Cramer et al., 2018) Whereas, the incidence proportion reported in studies examining yoga within the context of an randomized controlled trial have reported a lower frequency of injuries (intervention-related injuries: 0-14.1%, non-serious injuries: 0-48%, serious injuries: 0-2.8%) (Cramer et al., 2015) **Injury Rate Over Time** Studies have suggested that the amount of yoga-related injuries presenting at the emergency room has increased over time (Russell et al., 2016; Swain & McGwin, 2016). For example, Swain et al (2016) reported the injury rate increased overall from 2001 to 2014, from 9.55 per 100 000 participants in 2011 to 17.01 per 100 000 participants in 2014. **Common Injuries** The most common injuries/ adverse events include: 1) musculoskeletal strains and sprains accounting for an estimated 45-55% of all injuries, 2) digestive problems, 3) neurological problems and 5) respiratory events (Cramer et al., 2018; Russell et al., 2016). However, more serious, specific injuries can occur. These can include fractures, fibrocartilaginous injuries, lumbar disc annular tears, myositis ossificans, increased muscle enzymes), worsening preconditions (glaucoma, orbital varices, vein occlusion), peripheral neuropathy, stroke, transient headache, pneumothorax, and rectum sheath hematoma. (Cramer, Krucoff, & Dobos, 2013)	report found that the difference between males and females fluctuated from year to year. For example, in 2013 the estimated yoga related injury rate for females was 19.99 per 100 000 participants and the injury rate for males was 14.76 per 100 000 participants. Whereas, in 2014 the injury rate for females was 16.62 and the injury rate for males was 18.35 per 100 000. (Swain & McGwin, 2016) Another study reported that out of the 66 individuals who visited a Canadian emergency department for a yoga-related injury between 1991 and 2010, 48 cases were female. However, this study did not account for differences in the proportion of females who participate in yoga overall (female >male) (Russell et al., 2016). **Yoga Type/Style** Certain yoga types have been associated with an increased lifetime prevalence of injury. For example, one study found that hot yoga and Ashtanga Viyasa had the highest lifetime prevalence injury/adverse event: • hot yoga (any adverse event): 52.2% (95%CI: 44.4-60.0%) • Ashtanga Viyasa (MSK lasting longer than a month): 61.8% (95%CI: 52.8-70.8%) (Cramer et al., 2018) **Yoga Poses** Certain yoga practices are associated			

Injury Location The trunk (46.6%) was the most frequent region injured, followed by lower limb (21.94%), followed by head (16.93%) Rates (2014) Trunk: 8.41 per 100 000 participants Lower Limb: 3.92 per 100 000 participants Head: 3.49 per 100 000 participants	with a higher risk of injury: headstand (sirsasana), shoulder stand, lotus position (padmasana), forceful breathing techniques, forward or backward bends, and handstand. (Cramer et al., 2013, 2018) **Mechanisms of Injury** Over-stretching, stumbling into another participant, the surface (e.g. slippery surfaces) and equipment (e.g. tripping over a mat) have been identified as mechanisms of injury. The majority of injuries (43%) that were identified in the aforementioned study occurred while practicing a yoga pose. (Russell et al., 2016)			
Works Cited: Cramer, H., Krucoff, C., & Dobos, G. (2013). Adverse events associated with yoga: A systematic review of published case reports and Case Series. *PLoS ONE*, *8*(10). Cramer, H., Ostermann, T., & Dobos, G. (2018). Injuries and other adverse events associated with yoga practice: A systematic review of epidemiological studies. *Journal of Science and Medicine in Sport*, *21*(2), 147–154. Cramer, H., Ward, L., Saper, R., Fishbein, D., Dobos, G., & Lauche, R. (2015). The safety of yoga: A systematic review and meta-analysis of randomized controlled trials. *American Journal of Epidemiology*, *182*(4), 281–293. http://doi.org/10.1093/aje/kwv071	**Works Cited:** Cramer, H., Krucoff, C., & Dobos, G. (2013). Adverse events associated with yoga: A systematic review of published case reports and case series. *PLoS ONE*, *8*(10). Cramer, H., Ostermann, T., & Dobos, G. (2018). Injuries and other adverse events associated with yoga practice: A systematic review of epidemiological studies. *Journal of Science and Medicine in Sport*, *21*(2), 147–154. Russell, K., Gushue, S., Richmond, S., & McFaull, S. (2016). Epidemiology of yoga-related injuries in Canada from 1991 to 2010: a case series study. *International Journal of Injury Control*			

Russell, K., Gushue, S., Richmond, S., & McFaull, S. (2016). Epidemiology of yoga-related injuries in Canada from 1991 to 2010: a case series study. *International Journal of Injury Control and Safety Promotion*, *23*(3), 284–90. Swain, T. A., & McGwin, G. (2016). Yoga-Related injuries in the United States from 2001 to 2014. *Orthopaedic Journal of Sports Medicine*, *4*(11), 1–6.	*and Safety Promotion*, *23*(3), 284–90. Swain, T. A., & McGwin, G. (2016). Yoga-related injuries in the United States from 2001 to 2014. *Orthopaedic Journal of Sports Medicine*, *4*(11), 1–6.			

Review of Sport Injury Burden, Risk Factors and Prevention

Yoga

Incidence/Prevalence and Mechanisms of Injury

There are various types of yoga—from restorative (involves holding poses for extended periods of time) to powerflow yoga, which is faster, and more strength-based. Yoga has been recommended to help manage a number of health conditions including pain syndromes, cardiovascular conditions, musculoskeletal function, weight issues and psychological health (Büssing, Michalsen, Khalsa, Telles, & Sherman, 2012; Cramer, Ostermann, & Dobos, 2018).

Determining the incidence of yoga-related injuries is challenging because the majority of studies on yoga examine the number of injuries within the context of a randomized controlled trial whereby injury is not the primary outcome. In a systematic review containing yoga-related adverse events for 94 randomized control trials, the range in incidence proportions of intervention-related injuries spanned from 0 to 14.1%. In the same review, the incidence proportions for non-serious injuries ranged from 0 to 48%, and from 0 to 2.8% for serious injuries (Cramer et al., 2015). It is estimated that 1.45 injuries are sustained for every 1000 hours of yoga practice.

Studies have suggested that the amount of yoga-related injuries presenting at the emergency room has increased over time (Russell et al., 2016; Swain & McGwin, 2016). For example, Swain et al (2016) reported the injury rate increased overall from 2001 to 2014, from 9.55 per 100 000 participants in 2011 to 17.01 per 100 000 participants in 2014. However, whether this increase is due to increased participation in yoga or a shift to more people attempting yoga styles with increased risk has not been well established.

The most common injuries/adverse events in yoga include: 1) musculoskeletal strains and sprains accounting for an estimated 45-55% of all injuries, 2) digestive problems, 3) neurological problems and 5) respiratory events (Cramer et al., 2018; Russell et al., 2016). However, based on published case reports and case series, more serious injuries can occur. These can include fractures, fibrocartilaginous injuries, lumbar disc annular tears, myositis ossificans, increased muscle enzymes, worsening preconditions (glaucoma, orbital varices, vein occlusion), peripheral neuropathy, stroke, transient headache, pneumothorax, and rectum sheath hematoma (Cramer, Krucoff, & Dobos, 2013). Over-stretching, stumbling into another participant, the surface (e.g. slippery surfaces) and equipment (e.g. tripping over a mat) have been identified as common mechanisms of injury. (Russell et al., 2016)

Limitations of these data include non-representative samples, secondary analysis of databases not primarily designed to examine yoga injuries and assessment of adverse events that is not valid or reliable. For example, relying on case series and yoga-injuries seen at the emergency department may overestimate the number of severe and rare injuries.

Risk and Protective Factors

There are very few studies that have looked at what factors place someone at risk of an injury while participating in yoga.

Age

More research is needed to better understand how age affects the risk of injury while participating in yoga. However, there are a few studies to suggest that injury rate and severity may increase with age. For example, Swain et al. (2016) examined injury rates across 3 age groups and reported that older individuals have a higher rate of injury and Cramer et al (2018) reported that on average across 9 observational studies, adverse events were more often serious in participants above the age of 70 (Cramer et al., 2018). Only one study was identified examining injury specifically in children (n=32) who visited a Canadian emergency department. This study found that children were more likely than adults to be injured while being instructed versus practicing yoga at home (Russell et al., 2016). Further research is needed to better understand the rate and risk factors for yoga injuries in children.

Sex

Research examining injury rates stratified by sex is inconsistent. One study reported that the difference between males and females fluctuated from year to year. For example, in 2013 the estimated yoga related injury rate for females was 19.99 per 100 000 participants and the injury rate for males was 14.76 per 100 000 participants, whereas in 2014 the injury rate for females was 16.62 and the injury rate for males was 18.45 per 100 000 (Swain & McGwin, 2016). Another study reported that out of the 66 individuals who visited a Canadian emergency department for a yoga-related injury between 1991 and 2010, 48 cases were female. However, this study did not account for differences in the proportion of females who participate in yoga overall (female >male) (Russell et al., 2016).

Yoga Type/Style and Yoga Poses

Certain yoga types have been associated with an increased lifetime prevalence of injury. For example, one study found that hot yoga and Ashtanga Viyasa had the highest lifetime prevalence injury/adverse event: (Cramer et al., 2018) Furthermore, certain yoga practices are associated with a higher risk of injury. Therese include headstands (sirsasana), shoulder stands, the lotus position (padmasana), forceful breathing techniques, forward or backward bends, and handstands (Cramer et al., 2013, 2018).

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

The majority of research on yoga has focused on using yoga as an intervention for treatment or management for other chronic diseases. As such, there have been no studies specifically evaluating interventions for the prevention of injuries in Yoga. However, based on the injury data and mechanisms, there are some recommendations that may be helpful in reducing a participant's injury risk (Cramer et al., 2015, 2013, 2018; Russell et al., 2016). 1) Yoga participants should never push themselves to their limits and yoga instructors should never push their students to the limits. 2) Beginners should avoid advanced postures including the headstand, shoulder stand, lotus position or forceful breathing techniques. 3) Individuals with physical or mental conditions can practice yoga but should do so under the guidance of a trained yoga teacher and a medical professional, as certain yoga positions may be contraindicated. For example, it had been recommended that individuals with glaucoma should avoid headstands (Cramer et al., 2013).

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