ACTIVE & SAFE

Evidence Summary:
Dance

Tatum Priyambada Mitra, BSc BKin & Krystle Wittevrongel, BA BSc MPP

Version 1
February 2018

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.*

Authors: Tatum Priyambada Mitra and Krystle Wittevrongel

Editors: Sarah A Richmond, Amanda Black

For any questions regarding this report, contact:

BC Injury Research and Prevention Unit
F508 – 4480 Oak Street
Vancouver, BC V6H 3V4
Email: bcinjury1@cw.bc.ca
Phone: (604) 875-3776
Fax: (604) 875-3569
Website: www.injuryresearch.bc.ca

Suggested Citation:

Priyambada Mitra T, Wittevrongel K, Black A, Richmond SA, Babul S, Pike I. *Evidence Summary: Dance.* Active & Safe Central. BC Injury Research and Prevention Unit: Vancouver, BC; 2018.
Available at http://activesafe.ca/.

UBC BC Children's Hospital Research Institute

Evidence synthesis tool

SPORT:	Dance	Target Group:	All age ranges for dance (however focus on pre-professional and professional dancers)
Injury Types and Mechanisms:	Most common injuries in dance tend to be overuse injuries that result in chronic pain of the back and lower limbs and tendinopathy (Yin et al., 2016). In addition, traumatic incidents such as falls or landing incorrectly commonly result in fractures, sprains and strains within the lower extremities (Kenny, Whittaker, & Emery, 2015).		

Incidence/Prevalence	Risk Factors	Interventions	Implementation/ Evaluation	Resources
Pediatric The injury incidence rate in young dancers range from approximately 0.77-1.55 injuries per 1000 dance hours. (Akehurst & Oliver, 2014; Fuhrmann, Brayer, Andrus, & McIntosh, 2010; Kenny, Whittaker, & Emery, 2015) Injury rates differ depending on the age and sex of the dancers. Female dancers around the age of 8 have been reported to have an incidence of 1.05 injuries per 1000 hours, while female dancers around the age of 14 had incidence of 1.25 injuries per 1000 hours. (Yin et al., 2016; Steinberg et al., 2011). The prevalence of injuries within a study of paediatric dancers was found to be approximately 42.6% .(Yin et al., 2016) The most common injuries reported in dance, vary based on age. One study reported that among dancers ages 8–9 years, the most common injury was	Although evidence of risk factors is lacking, suggested risk factors for injury include previous injury, psychological factors (insufficient coping skills, mood, perfectionism, stress), anthropometrics (low BMI and adiposity and increased thigh circumference), poor aerobic capacity, timing of season, range of motion, risky movements and technique, overtraining, age, sex, and experience. (Steinberg et al., 2011; Kenny, Whittaker, & Emery, 2015) **Previous Injury** Multiple studies have suggested that dancers who have been injured in the past have a higher risk of re-injury. (Kenny, Whittaker, & Emery, 2015; Steinberg et al., 2011) In addition, inadequate recovery time and improper rehabilitation are possible mechanisms behind previous injury as a risk factor.	There were no studies found that specifically examined the effectiveness of interventions to reduce injury in dance. **Economic** There is limited information on the costs of injury and injury prevention in dance. One study identified wiyth a three-year injury prevention program for dancers that included treatment and physiotherapy, there was a 34% decline in total injury incidence, 66% decrease in Workers Compensation claims, and 56% decrease in lost days. (Ojofeitimi & Bronner, 2011)	There is limited information on the evaluation of programs for injury prevention; however, studies show that once injury prevention programs are implemented, they might be able to reduce the number of injuries and healthcare costs (Ojofeitimi & Bronner, 2011). One study focused on education and the importance of injury prevention and found that all participants felt that dance-related injuries and injury prevention were useful topics to cover in a dance curriculum. (Fuhrmann et al., 2010) In addition, it is reported that approximately 92% of respondents wished they had more training within these areas. The majority also stated that cardiovascular exercise and weight management were useful topics that should be covered in more detail. (Fuhrmann et al., 2010) It should also be noted that there is a lack of high quality studies as most studies do not define injury and they do not consider multiple	**Websites** Stop Sport Injuries Information Sheet http://www.stopsportsinjuries.org/STOP/STOP/Prevent_Injuries/Dance_Injury_Prevention.aspx

tendonitis (Steinberg et al., 2011) while another study found that the most common injuries in pediatric dancers were tendonitis/ tendinopathy, patellofemoral pain syndrome, apophysitis, ankle impingement syndrome, and hip labral tears. (Yin et al., 2016) The most common injury sites in pediatric dance populations have been reported to be the knee and ankle. (Yin et al., 2016) Steinberg et al. (2011) found the most common injury sites among adolescent dancers ages 14–16 years were knee injuries. **Adult Non-Professional Dancers** The incidence of injury among amateur dancers is reported as 0.99 injuries per 1,000 hours in males and 1.09 injuries per 1,000 dance hours in females. (Kenny, Whittaker, & Emery, 2015) Out of all injuries in non-professional dancers, approximately 75% of injuries are due to overuse. (Kenny et al., 2017) The most common injury sites in this population include the lower extremities such as knees and ankles. (Kenny et al., 2017; Yin et al., 2016)	**Sex** The rate of injury in multiple studies has been shown to be lower in males, however, more information is needed about sex as a risk factor for injury. (Kenny, Whittaker, & Emery, 2015) **BMI** A low BMI and low adiposity have been identified as risk factors for injury. (Kenny, Whittaker, & Emery, 2015) **Psychological Coping Skills and Timing of Season** All sports include psychological component and within dance, a modifiable risk factor for injury in pre-professional has been ability to cope with fear, stress and self-esteem. (Kenny, Whittaker, & Emery, 2015) Auditioning, perfect technique, relationships with choreographers, and maintaining a low or ideal body weight some of the stressors faced by dancers. In addition, the time period preceding competitive auditions and before and during performances have been identified as risk factors due to the increased stress experienced by dancers during these times. (Kenny,		risk factors that lead to injury. (Kenny, Whittaker, & Emery, 2015) One study investigated the efficiency of a comprehensive management program for five years, which involved primary prevention (i.e. dance-specific annual screenings, technique modification, cross-training, and treatment of minor complaints) and secondary prevention (on-site case management and intervention) and found these mechanisms were a successful way to prevent injuries. (Hincapié et al., 2008)	

Adult Professional Dancers In professional dancers, the incidence of injury is reported as 1.06 per 1,000 hours in males and 1.46 injuries per 1,000 dance hours in females. (Kenny, Whittaker, & Emery, 2015) Compared to their non-professional counterparts, 64% of female and 50% of male professional dancers reported that their injuries were overuse in nature. (Kenny, Whittaker, & Emery, 2015) The common injury sites in professional dancers depend on the type of dance; however, foot and ankle injuries represent the majority of injuries seen in professional ballet dancers. (Kenny et al., 2017; Yin et al., 2016) **Injury Definition and Incidence** One of the challenges of quantifying injury in a dance population is the use of a time-loss definition of injury to define injury incidence. (Kenny et al., 2017) When dance injury prevalence was collected using a time-loss definition, medically identified definition and an all complaint definition, the prevalence was shown to vary from 9.41% (95%	Whittaker, & Emery, 2015) **Range of Motion and Risky Movements** Depending on the type of dance, the more technical types of dance (such as ballet) require maximal range of motion. Dancers may attempt to go past comfortable ranges in order to perform movements which can lead to injury. (Akehurst & Oliver, 2014; Hincapié, Morton, & Cassidy, 2008) **Overtraining and Experience** It is no surprise that overtraining is a common risk factor for injury in dance, as in most sports. (Akehurst & Oliver, 2014; Hincapié et al., 2008; Kenny, Whittaker, & Emery, 2015; Sobrino, de la Cuadra, & Guillén, 2015; Yin et al., 2016) In addition to overtraining, overuse injuries are also common for dancers. (Sobrino, de la Cuadra, & Guillén, 2015) However, overtraining is an under-researched area within dance. More information is needed about the effects of overtraining and how to better prevent it or overuse injuries for dancers. Another suggested research area is experience as a protective factor against injury risk; however, there are no			

CI: 4.15, 17.71; time loss) to 82.35% (95% CI: 72.56, 89.77; all complaint). (Kenny et al., 2017)	studies to confirm this. (Hincapié et al., 2008)			
Works Cited: Akehurst, S. & Oliver, E. J. (2014). Obsessive passion: a dependency associated with injury-related risky behaviour in dancers. *Journal of Sports Sciences, 32* (3), 259–267. Fuhrmann, T.L., Brayer, A., Andrus, N., & McIntosh, S. (2010). Injury prevention for modern dancers: a pilot study of an educational intervention. *Journal of Community Health 35,* (5), 527–533. Kenny, S.J., Whittaker, J.L., & Emery, C.A. (2015). Risk factors for musculoskeletal injury in preprofessional dancers: a systematic review. *British Journal of Sports Medicine,* 0, 1-8. Kenny, S., Palacios-Derflingher, L., Whittaker, J*.,* & Emery, C. (2017). Does injury definition matter? The influence of injury definition on interpretations of injury risk in pre-professional ballet and contemporary dancers. *British Journal of Sports Medicine,* 51(4), :339-340.	**Works Cited:** Akehurst, S. & Oliver, E. J. (2014). Obsessive passion: a dependency associated with injury-related risky behaviour in dancers. *Journal of Sports Sciences*, 32 (3), 259–267. Hincapié, C.A., Morton, E.J., & Cassidy, J.D. (2008). Musculoskeletal injuries and pain in dancers: a systematic review. *Archives of Physical Medicine and Rehabilitation,* 89 (9), 1819–1829. Kenny, S.J., Whittaker, J.L., & Emery, C.A. (2015). Risk factors for musculoskeletal injury in pre-professional dancers: a systematic review. British *Journal of Sports Medicine*, 0, 1-8. Sobrino, F.J., de la Cuadra, C., & Guillén, P. (2015). Overuse injuries in professional ballet: Injury-based differences among ballet disciplines. *Orthopaedic Journal of Sports Medicine*, 3(6), 2325967115590114. Steinberg, N., Siev-Ner, I., Peleg, S., Dar, G., Masharawi, Y., Zeev,	**Works Cited:** Ojofeitimi, S. & Bronner, S. (2011). Injuries in a modern dance company effect of comprehensive management on injury incidence and cost. *Journal of Dance Medicine & Science*, 15 (3), 116–122.	**Works Cited:** Hincapié, C.A., Morton, E.J., & Cassidy, J.D. (2008). Musculoskeletal injuries and pain in dancers: a systematic review. *Archives of Physical Medicine and Rehabilitation,* 89(9), 1819–1829. Kenny, S.J., Whittaker, J.L., & Emery, C.A. (2015). Risk factors for musculoskeletal injury in pre-professional dancers: a systematic review. *British Journal of Sports Medicine*, 0, 1-8. Ojofeitimi, S. & Bronner, S. (2011). Injuries in a modern dance company effect of comprehensive management on injury incidence and cost. *Journal of Dance Medicine & Science* , 15(3), 116–122.	

Steinberg, N., Siev-Ner, I., Peleg, S., Dar, G., Masharawi, Y., Zeev, A., & Hershkovitz, I. (2011). Injury patterns in young, non-professional dancers. *Journal of Sports Sciences*, 29(1), 47–54. Yin, A. X., Sugimoto, D., Martin, D.J., & Stracciolini, A. (2016). Pediatric Dance Injuries : A Cross-Sectional Epidemiological Study. *PM&R: Journal of Injury, Function and Rehabilitation*, 8(4), 348–355.	A., & Hershkovitz, I. (2011). Injury patterns in young, non-professional dancers. *Journal of Sports Sciences*, 29(1), 47–54. Yin, A. X., Sugimoto, D., Martin, D.J., & Stracciolini, A. (2016). Pediatric dance injuries: A cross-sectional epidemiological study. *PM&R: Journal of Injury, Function and Rehabilitation,* 8(4), 348–355.			

Review of Sport Injury Burden, Risk Factors and Prevention

Dance

Incidence and Prevalence

Regardless of style or level of participation, dancers are particularly susceptible to injury as a result of the extreme amounts of physical exertion and movement required. (Hincapié, Morton, & Cassidy, 2008; Kenny, Whittaker, & Emery, 2015)

For children and adolescents, the incidence rate of injury ranges between 0.77-1.55 per 1,000 dance hours. (Akehurst & Oliver, 2014; Fuhrmann et al., 2010; Steinberg et al., 2011; Kenny, Whittaker, & Emery, 2015; Yin et al., 2016) According to Smith et al. (2015) injury rates in adolescent ballet are comparable to other sports such as gymnastics or soccer with a rate of 4.7 per 1,000 dance hours compared to 4.5 and 2.6 for soccer and gymnastics, respectively.

For adults, the incidence rate of injuries for amateur ballet dancers reported in the literature is 0.99 per 1,000 dance hours for males and 1.09 per 1,000 dance hours for females. (Smith et al., 2015) Of the injuries reported, 75% were attributed to overuse among both males and females. (Smith et al., 2015) In the professional dance population, the incidence rate of injury is reportedly higher, with 1.06 injuries per 1,000 dance hours for males and 1.46 for females. (Smith et al., 2015) In the professional population, it is reported that females are more likely to sustain overuse injuries, compared to males (64% of female injuries were attributed to overuse as compared to 50% for males). (Smith et al., 2015)

The most common injuries reported in dance, vary based on age. One study reported among pediatric dancers, the most common injury was tendonitis (Steinberg et al., 2011) while another study found patellofemoral pain syndrome, apophysitis, ankle impingement syndrome, and hip labral tears, as the most common injuries. (Yin et al., 2016) According to a 2015 systematic review completed by Smith et al., lower extremity injuries accounted for 66%-91% of all ballet injuries, with the foot and ankle comprising 14%-57% of all total injuries for adults. The most common injury sites in pediatric dance populations have been reported to be the knee and ankle, injury sites consistent with those seen in adults. (Steinberg et al., 2011; Yin et al., 2016; Kenny et al., 2017)

One of the challenges of quantifying injury in a dance population is the use of a time-loss definition of injury to define injury incidence. (Kenny et al., 2017) When dance injury prevalence was collected using a time-loss definition, medically identified definition and an all complaint definition, the prevalence was shown to vary from 9.41% (95% CI: 4.15, 17.71; time loss) to 82.35% (95% CI: 72.56, 89.77; all complaint). (Kenny et al., 2017)

Currently, the data are limited on specific incidence rates across all types of dance. Furthermore, there are limited studies on professional dancers that cover the specific clinical diagnoses or type of injury based on the type of dance the dancer practices. Recent literature

suggests the incidence of injury may also be underestimated due to studies using a time-loss definition for injuries. (Kenny, Whittaker, & Emery, 2015; Smith et al., 2015; Sobrino, de la Cuadra, & Guillén, 2015)

Risk and Protective Factors

Although the evidence of risk factors is lacking, suggested risk factors for injury include previous injury, psychological factors (insufficient coping skills, mood, perfectionism, stress), anthropometrics (low BMI and adiposity and increased thigh circumference), poor aerobic capacity, timing of season, range of motion, risky movements and technique, overtraining, age, sex, and experience. (Hincapié et al., 2008; Kenny et al., 2015; Steinberg et al., 2011; Yin et al., 2016) Due to the nature of the sport and the aesthetic component, additional risk factors such as range of motion, flexibility, bone mineral density and diet should also be taken into account as risk factors. (Hincapié et al., 2008; Kenny et al., 2015; Steinberg et al., 2011)

The incidence and prevalence rate of injury in females performing dance is reportedly higher than males, but rates vary according to the literature. (Hincapié et al., 2008; Steinberg et al., 2011) There is a limited amount of information on the effects of age as a risk factor for dance injuries; however, both advanced age and increased exposure to dance have been identified as risk factors that might explain the increased injury incidence in females. (Hincapié et al., 2008; Steinberg et al., 2011)

The most common type of injuries seen in dance are overuse injuries which may be due to fatigue and overtraining. (Hincapié et al., 2008; Steinberg et al., 2011; Yin et al., 2016) Additional stressors for dancers include competitive auditions, timing of performances, relationships with choreographers and other dancers, body weight and body image pressure, and isolation from loved ones. (Hincapié et al., 2008; Kenny et al., 2015)

Modifiable risk factors for injury in dance can include previous injury and insufficient psychological coping skills. (Kenny et al., 2015; Steinberg et al., 2011) Risk factors for re-injury can be due to multiple causes, which include inadequate healing time; lack of proper rehabilitation and the possibility of the repeated mechanism of the previous injury being executed without proper strengthen of muscles surrounding the injured sites. (Kenny et al., 2015; Steinberg et al., 2011) Since dance is extremely technical, one protective factor would be proper technique execution and proper instruction.

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

While a number of authors have provided recommendations for how dance injuries can be prevented, the majority of programs have not been rigorously evaluated. (Fuhrmann, Brayer, Andrus, & McIntosh, 2010; Hincapié et al., 2008; Yin et al., 2016) One of the recommendations that can help prevent injuries is the use of individualized conditioning programs based on the functional movement and common injury types seen within the specific type of dance. By using

this program, individuals might be able to use specific exercises and specific resistance training to help reduce biomechanical imbalances within the body and strengthen areas that are more susceptible to injury. (Yin et al., 2016) The most common types of injuries seen in dance tend to be due to overuse; therefore, the use of periodization and tapering classes and rehearsals before major performances and auditions may help prevent fatigue or overtraining-related injury. (Steinberg et al., 2011; Yin et al., 2016)

Another component of injury prevention could be education on safety measures for dance and potentially implementing a prevention program that focuses on injury prevention knowledge. The implementation of this program would be beneficial particularly at a young age. (Fuhrmann et al., 2010; Yin et al., 2016) A study by Fuhrmann et al. (2010) examined behaviours of dancers following educational interventions and indicated that dancers perceive educational courses on injury prevention as useful and tend to recall the information provided for at least a short period of time. (Fuhrmann et al., 2010) It is unclear; however, how this educational intervention affected injury rates in the population studied. There are very few studies looking at the economic costs of injury in dance and a lack of information on costs of injuries within each genre as well as overall costs of injury within dance. One study found that through the use of an injury prevention program that for every dollar spent on the program, they saved over $3.98, as compared to savings of $1.45 if the program had not been sponsored. (Ojofeitimi & Bronner, 2011). In addition, there is limited information on specific training programs that could limit injuries within specific fields of dance.

References

Fuhrmann, T. L., Brayer, A., Andrus, N., & McIntosh, S. (2010). Injury prevention for modern dancers: a pilot study of an educational intervention. *Journal of Community Health, 35*(5), 527–533.

Hincapié, C.A., Morton, E.J., & Cassidy, J.D. (2008). Musculoskeletal injuries and pain in dancers: A systematic review. *Archives of Physical Medicine and Rehabilitation, 89*(9), 1819–1829.

Kenny, S.J., Whittaker, J.L., & Emery, C.A. (2015). Risk factors for musculoskeletal injury in preprofessional dancers: a systematic review. *British Journal of Sports Medicine,* 0, 1-8. doi: 10,1136:\bjsports–2015-095121.

Kenny, S., Palacios-Derflingher, L., Whittaker, J., & Emery, C. (2017). Does injury definition matter? The influence of injury definition on interpretations of injury risk in pre-professional ballet and contemporary dancers. *British Journal of Sports Medicine,* 51(4), 339-340.

Ojofeitimi, S. & Bronner, S. (2011). Injuries in a modern dance company effect of comprehensive management on injury incidence and cost. *Journal of Dance Medicine & Science, 15*(3), 116–122.

Smith, P.J., Gerrie, B.J., Varner, K.E., McCulloch, P.C., Lintner, D.M., & Harris, J.D. (2015). Incidence and prevalence of musculoskeletal injury in ballet: A systematic review. *Orthopaedic Journal of Sports Medicine, 3*(7), 2325967115592621.

Sobrino, F.J., de la Cuadra, C., & Guillén, P. (2015). Overuse injuries in professional ballet: Injury-based differences among ballet disciplines. *Orthopaedic Journal of Sports Medicine, 3*(6): 2325967115590114.

Steinberg, N., Siev-Ner, I., Peleg, S., Dar, G., Masharawi, Y., Zeev, A., & Hershkovitz, I. (2011). Injury patterns in young, non-professional dancers. *Journal of Sports Sciences, 29*(1), 47–54.

Yin, A.X., Sugimoto, D., Martin, D.J., & Stracciolini, A. (2016). Pediatric dance injuries: a cross-sectional epidemiological study. *PM&R; Journal of Injury, Function and Rehabilitation, 8*(4), 348–355.