



Evidence Summary: Boxing

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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:	Boxing	Target Group:	Adults	
Injury Mechanisms:	Common injury types in boxing include contusions, fractures, sprains/strains and concussions. ¹⁻⁴ Common mechanisms for injury in boxing include forceful contacts with ones opponent.			
Incidence/ Prevalence	Risk/ Protective Factors	Interventions	Implementation/ Evaluation	Resources
<p>Boxing (General) Studies of boxing in general (not based on level or experience) report that nearly half of all boxers have experienced an injury.¹ Of combat injuries seen in the emergency department, 10.3% of were the result of boxing.² It is reported that an average of 8716 injuries occur per year in boxing (of which females had and injury rate of 8.9 injuries and males had an injury rate of 13.3).³ Of all boxing injuries, it is reported that 57% of them occur during competition.⁴</p> <p>Zazryn, et al. (2006) reported an overall injury rate of 44.7 injuries per 100 boxers, 2.0 injuries per 1000 hours of participation.⁴ The competition injury rate varies from 1081.1-1221.4 injuries per 1000 bout hours.⁴ Whereas, training injuries rates were much lower, 0.5-1.7 injuries per 1000 hours of participation.⁴</p> <p>Injury types in boxing vary; studies report that contusions accounted for between 27.2%</p>	<p>There is limited literature that examines the relationship with risk factors and injury in boxing. Some studies cited below made comparisons of incidence data, by subgroup.</p> <p>Boxing (Amateur) <u>Weight</u> Loosemore, et al. (2015) reported significant differences in injury rates between the different weight classes (48 kg – 91 kg +); however, weight class was not assessed as an independent risk factor.⁶</p> <p>Boxing (Professional) <u>Match outcome</u> A literature review on boxing injuries reports that the losing boxer of a match is more than twice as likely to sustain an injury, compared to the winner.⁹ Injured professional boxers are significantly more likely to lose a match or end their match early as a result of their injury.⁸</p> <p><u>Frequency of matches</u></p>	<p>There are no studies that evaluated the effectiveness of an intervention on injury outcomes in boxing.</p> <p>Rule Changes One study examined the effects on injury rates in relation to specific rule changes within boxing. This study noted that rule changes enforced by officials or having objective means of scoring matches, can make the sport fair to both participants but also safer.¹⁸ Additionally, it was noted that some of the rule changes counteracted the effects of previous rule changes which resulted in higher rates of injury.¹⁸</p> <p>Equipment Studies which examined the effectiveness of equipment interventions in boxing focused on headgear and hand protection interventions.¹⁴⁻¹⁷ These studies were all lab based and determined which of the</p>	<p>Emerich & Nadolska-Gazda (2013) and Tulunoglu & Ozbek (2006) discuss mouthguard use behaviour and awareness regarding the prevention of dental injury.^{12,13} Both studies concluded that more needs to be done from a knowledge intervention perspective to promote the use of mouthguards.^{12,13}</p>	<p>Websites Boxing Ontario http://boxingontario.com/safe-sport/injury-prevention/</p> <p>Ontario injury prevention resource centre http://www.oninjuryresources.ca/home/</p> <p>Government of Canada https://www.canada.ca/en/public-health/services/injury-prevention.html</p> <p>Ontario Kinesiology Association http://www.oka.on.ca/site/home</p> <p>Ontario Brain Injury Association http://obia.ca/brain-injury-information/</p> <p>Parachute http://www.parachutecanada.org/injury-topics</p> <p>Other</p>

<p>and 44% of injuries,^{1,2} fractures between 19.0% and 27.5% of injuries,²⁻⁴ sprains/strains between 20.4% and 22% of injuries,^{2,3} concussions between 5.1% and 10.4% of injuries,^{1,3} lacerations between 8.8% and 29% of injuries.^{3,4} Twenty-six percent of injuries affected the soft tissue,³ and 3.7% were dislocations.³</p> <p>The study by Zazryn, et al. (2006) report that of the injuries occurring during competition, 71% are head injuries, of which 47% are considered concussions.⁴</p> <p>The anatomical location of injury in boxing varies between studies. It is reported that 9%-96% of injuries are to the head or face,^{2,5} upper extremity injuries account for between 2% and 63.7% of injuries,^{2,5} 33% of injuries involved the hand,³ 0%-16% of injuries affect the trunk,^{2,5} 0%-24% of injuries affect the lower extremities,⁵ and 22.5% of injuries involve the head or neck.³</p> <p>Boxing (Amateur) It is reported that 60.6% of amateur boxers sustain an injury, and 70% of them occur during training.⁶ This study reports an</p>	<p>Boxers who fight more frequently have higher rates of injury.⁸</p> <p>Kickboxing</p> <p><u>Sex</u> Based on the rate ratio per 1000 minutes of exposure, males (RR=1.81 [95%CI: 1.24-2.66]) had a higher rate of injury than females.¹¹</p> <p><u>Competition level</u> Based on the rate ratio per 1000 minutes of exposure, professional kickboxers had a higher rate of injury than amateurs (RR=2.28 [95%CI: 1.26-4.12]).¹¹</p> <p><u>Weight</u> Based on the rate ratio per 1000 minutes of exposure those in the heavy weight class had a higher rate of injury compared to both the light (RR=1.82 [95%CI: 1.35-2.45]) and middle (RR=1.40 [95%CI: 1.13-1.75]) weight classes.¹¹</p> <p><u>Match outcome</u> Based on the rate ratio per 1000 minutes of exposure injury rates are higher for the athletes that lose a match than those who win the match RR=3.48 (95%CI: 2.73-4.44).¹¹ Injury rate ratios were also</p>	<p>available equipment was the most protective brand and type available to boxers.</p> <p>There is no data examining the cost effectiveness of interventions to reduce injuries in boxing.</p>		<p>Boxing Ontario Boxing Injury Management Program http://20188-presscdn.pagely.netdna-cdn.com/wp-content/uploads/Inj_Prgm_singpage_proof7.pdf</p>
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<p>injury rate of 828 injuries per 1000 hours of competition, 82.8% of injuries were new, whereas 17.2% were recurring. An average of 7.4 injuries was sustained by the athletes who reported injuries.⁶</p> <p>In amateur boxing, hand injuries represent 23% of injuries, wrists 10.4% of injuries, 7.7% are elbow injuries, 7.4% are ankle injuries, and 7.1% are shoulder injuries.⁶ A Korean study examined the frequency of injury locations in athletes who reported having one or more previous injuries.⁷ In these athletes, 18.8% report sustaining a neck injury, 43.8% sustaining face injuries, 18.8% sustaining head injuries, 6.3% sustaining chest injuries, 37.5% sustaining low back injuries, 6.3% sustaining back injuries (other than the lower back), and 50% of athletes sustaining injuries to both the left and right wrists.⁷</p> <p>Based on injury diagnosis 100% of the participants in the study by Noh, et al. (2015) report sustaining musculoskeletal injuries, 25% report skin injuries, 12.5% report nerve injuries, 56.3% report fractures, 37.5% report ruptured ligaments, 68.8% report sprains/strains, 25% report herniated disc(s), and 75%</p>	<p>much higher when a match ended in either a knockout (KO) or a technical knockout (TKO) RR=5.30 (95%CI: 4.31-6.52).¹¹</p>			
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report bruising.⁷

Boxing (Professional)

The injury rates reported in studies of professional boxers vary. A study by Zazryn, et al. (2009) report that 19.5% of fights had completed injury reports, resulting in a rate of 23.6 injuries per 100 professional fights. KO (knock out) and TKO (technical knock out) losses result in an injury rate of 60.7 per 100 fights.⁸ Whereas, a study by Bledsoe, et al. (2005) report the overall incidence rate of injuries as 17.1 per 100 boxer-matches or 3.4 per 100 boxer-rounds.⁹

For professional boxers, lacerations are reported to occur between 21.9% and 61.7% of the time,^{8,10} contusions 36% of the time,¹⁰ concussions 4.2% to 11.7% of the time,^{8,10} muscle injuries 13% of the time,¹⁰ 8.3% of athletes report low back pain or disc herniation,¹⁰ fractures to the hands, fingers, or nose 8.4% of the time,⁸ or fractures with no specified location occurring 1.6% of the time.¹⁰

Kickboxing

The injury rate of professional and amateur kickboxers is reported as 390.1 injuries per 1000 athlete exposures and 39.7

<p>injuries per 1000 minutes of exposure.¹¹</p> <p>Of the injuries reported in kickboxing, 57.8% are injuries to the head and 26.1% to the lower limb. The most common injury reported is lacerations (70.6%) and fractures (20.6%).¹¹</p>				
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Review of Sport Injury Burden, Risk Factors and Prevention

Boxing and Kickboxing

This report includes studies that reviewed incidence/prevalence, risk factors, and interventions and their implementation in boxing both in general and based on experience and in kickboxing.

Incidence and Prevalence

Boxing (General)

Studies of boxing in general (not based on level or experience) report that nearly half of all boxers have experienced an injury (Karpman, et al., 2016). Of combat injuries seen in the emergency department, 10.3% were the result of boxing (Pappas, 2007). It is reported that an average of 8716 injuries occur per year in boxing (of which females had an injury rate of 8.9 injuries and males had an injury rate of 13.3) (Potter, Snyder, & Smith, 2011).

Of all boxing injuries, it is reported that 57% of them occur during competition (Zazryn, Cameron, & McCrory, 2006). Zazryn, Cameron, & McCrory, et al. (2006) reported an overall injury rate of 44.7 injuries per 100 boxers, 2.0 injuries per 1000 hours of participation. The competition injury rate varies from 1081.1-1221.4 injuries per 1000 bout hours (Zazryn et al., 2006). Whereas, training injuries rates were much lower, 0.5-1.7 injuries per 1000 hours of participation (Zazryn et al., 2006).

Injury types in boxing vary; studies report that contusions accounted for between 27.2% and 44% of injuries (Karpman et al., 2016; Pappas, 2007), fractures between 19.0% and 27.5% of injuries (Pappas, 2007; Potter et al., 2011; Zazryn et al., 2006), sprains/strains between 20.4% and 22% of injuries (Pappas, 2007; Potter et al., 2011), concussions between 5.1% and 10.4% of injuries (Karpman et al., 2016; Potter et al., 2011), lacerations between 8.8% and 29% of injuries (Potter et al., 2011; T. Zazryn et al., 2006). Twenty-six percent of injuries affected the soft tissue (Potter et al., 2011), and 3.7% were dislocations (Potter et al., 2011). The study by Zazryn, et al. (2006) reported that of the injuries occurring during competition, 71% are head injuries, of which 47% are considered concussions. (T. Zazryn et al., 2006)

It is reported that 9%-96% of injuries are to the head or face (Loosemore et al., 2015; Pappas, 2007), upper extremity injuries account for between 2% and 63.7% of injuries (Loosemore, Lightfoot, & Beardsle, 2015; Pappas, 2007), 33% of injuries involved the hand (Potter et al., 2011), 0%-16% of injuries affect the trunk (Loosemore et al., 2015; Pappas, 2007), 0%-24% of injuries affect the lower extremities (Loosemore et al., 2015), and 22.5% of injuries involve the head or neck (Potter et al., 2011).

Boxing (Amateur)

It is reported that 60.6% of amateur boxers sustain an injury, and 70% of them occur during training (Loosemore et al., 2015). This study reports an injury rate of 828 injuries per 1000 hours of competition, 82.8% of injuries were new, whereas 17.2% were recurring. An average of 7.4 injuries was sustained by the athletes who reported injuries (Loosemore et al., 2015). In amateur boxing, hand injuries represent 23% of injuries, wrists 10.4% of injuries, 7.7% are elbow injuries, 7.4% are ankle injuries, and 7.1% are shoulder injuries (Loosemore et al., 2015). A Korean study examined the frequency of injury locations in athletes who reported having one or more previous injuries (Noh et al., 2015). In these athletes, 18.8% report sustaining a neck injury, 43.8% sustaining face injuries, 18.8% sustaining head injuries, 6.3% sustaining chest injuries, 37.5% sustaining low back injuries, 6.3% sustaining back injuries (other than the lower back), and 50% of athletes sustaining injuries to both the left and right wrists (Noh et al., 2015). Based on injury diagnosis 100% of the participants in the study by Noh, et al. (2015) report sustaining musculoskeletal injuries, 25% report skin injuries, 12.5% report nerve injuries, 56.3% report fractures, 37.5% report ruptured ligaments, 68.8% report sprains/strains, 25% report herniated disc(s), and 75% report bruising (Noh et al., 2015).

Boxing (Professional)

The injury rates reported in studies of professional boxers vary. A study by Zazryn, et al. (2009) report that 19.5% of fights had completed injury reports, resulting in a rate of 23.6 injuries per 100 professional fights. KO (knock out) and TKO (technical knock out) losses result in an injury rate of 60.7 per 100 fights (Zazryn, McCrory, & Cameron, 2009). Whereas, a study by Bledsoe, et al. (2005) report the overall incidence rate of injuries as 17.1 per 100 boxer-matches or 3.4 per 100 boxer-rounds (Bledsoe, Li, & Levy, 2005). For professional boxers, lacerations are reported to occur between 21.9% and 61.7% of the time (Siewe et al., 2015; T. R. Zazryn et al., 2009), contusions 36% of the time (Siewe et al., 2015), concussions 4.2% to 11.7% of the time (Siewe et al., 2015; T. R. Zazryn et al., 2009), muscle injuries 13% of the time (Siewe et al., 2015), 8.3% of athletes report low back pain or disc herniation (Siewe et al., 2015), fractures to the hands, fingers, or nose 8.4% of the time (T. R. Zazryn et al., 2009), or fractures with no specified location occurring 1.6% of the time (Siewe et al., 2015).

Kickboxing

The injury rate of professional and amateur kickboxers is reported as 390.1 injuries per 1000 athlete exposures and 39.7 injuries per 1000 minutes of exposure (Lystad, 2015). Of the injuries reported in kickboxing, 57.8% are injuries to the head and 26.1% to the lower limb. The most common injury reported is lacerations (70.6%) and fractures (20.6%) (Lystad, 2015).

The majority of boxing literature reports on males and injuries in young adults, thus the information regarding injury incidence outside of these populations, is limited. Few studies looked at specific groups of boxers over a period of time and many studies did not report on recurring injuries for athletes. These studies also did not report the turnover in boxing for the study period. Studies have reported on injury location and type, but none have reviewed causes of the reported injuries.

Risk and Protective Factors

There is a lack of literature that examines the relationship between risk factors and injury in boxing. Some studies report comparisons of incidence data, by subgroup.

Boxing (Amateur)-Weight

Loosemore, et al. (2015) reported significant differences in injury rates between the different weight classes (48 kg – 91 kg +); however, weight class was not assessed as an independent risk factor.

Boxing (Professional)

Match outcome

A literature review on boxing injuries reports that the losing boxer of a match is more than twice as likely to sustain an injury, compared to the winner (Bledsoe et al., 2005). Injured professional boxers are significantly more likely to lose a match or end their match early as a result of their injury (Zazryn, McCrory, & Cameron, 2009).

Frequency of matches

Boxers who fight more frequently have higher rates of injury (Zazryn et al., 2009).

Kickboxing

Sex

Based on the rate ratio per 1000 minutes of exposure, males (RR=1.81 [95%CI: 1.24-2.66]) had a higher rate of injury than females (Lystad, 2015).

Competition level

Based on the rate ratio per 1000 minutes of exposure, professional kickboxers had a higher rate of injury than amateurs (RR=2.28 [95%CI: 1.26-4.12]) (Lystad, 2015).

Weight

Based on the rate ratio per 1000 minutes of exposure those in the heavy weight class had a higher rate of injury compared to both the light (RR=1.82 [95%CI: 1.35-2.45]) and middle (RR=1.40 [95%CI: 1.13-1.75]) weight classes (Lystad, 2015).

Match outcome

Based on the rate ratio per 1000 minutes of exposure injury rates are higher for the athletes that lose a match than those who win the match RR=3.48 (95%CI: 2.73-4.44) (Lystad, 2015). Injury rate ratios were also much higher when a match ended in either a knockout (KO) or a technical knockout (TKO) RR=5.30 (95%CI: 4.31-6.52) (Lystad, 2015).

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

There are no studies that evaluated the effectiveness of an intervention on injury outcomes in boxing. Also there is no data examining the cost effectiveness of interventions to reduce injuries in boxing.

Rule Changes

One study examined the effects on injury rates in relation to specific rule changes within boxing. This study noted that rule changes enforced by officials or having objective means of scoring matches, can make the sport fair to both participants but also safer (Bianco et al., 2013). Additionally, it was noted that some of the rule changes counteracted the effects of previous rule changes which resulted in higher rates of injury (Bianco et al., 2013).

Equipment

Studies which examined the effectiveness of equipment interventions in boxing focused on headgear and hand protection interventions (Bartsch, et al., 2012; Loosemore et al., 2017; McIntosh & Patton, 2015; Mcintosh & Patton, 2015). These studies were all lab-based and were meant to determine which of the available equipment was the most protective brand and type available to boxers.

Implementation and Evaluation

Emerich & Nadolska-Gazda (2013) and Tulunoglu & Özbek (2006) discuss mouthguard use behaviour and awareness regarding the prevention of dental injury (Emerich & Nadolska-Gazda, 2013; Tulunoglu & Özbek, 2006). Both studies concluded that more needs to be done from a knowledge intervention perspective to promote the use of mouthguards (Emerich & Nadolska-Gazda, 2013; Tulunoglu & Özbek, 2006).

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