



Policy Statement—Boxing Participation by Children and Adolescents

AMERICAN ACADEMY OF PEDIATRICS, COUNCIL ON SPORTS
MEDICINE AND FITNESS, CANADIAN PAEDIATRIC SOCIETY,
HEALTHY ACTIVE LIVING AND SPORTS MEDICINE COMMITTEE

KEY WORDS

boxing, youth, children and adolescents, head injuries,
concussion

ABBREVIATIONS

RTP—return to play

CTE—chronic traumatic encephalopathy

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abstract

FREE

Thousands of boys and girls younger than 19 years participate in boxing in North America. Although boxing provides benefits for participants, including exercise, self-discipline, and self-confidence, the sport of boxing encourages and rewards deliberate blows to the head and face. Participants in boxing are at risk of head, face, and neck injuries, including chronic and even fatal neurologic injuries. Concussions are one of the most common injuries that occur with boxing. Because of the risk of head and facial injuries, the American Academy of Pediatrics and the Canadian Paediatric Society oppose boxing as a sport for children and adolescents. These organizations recommend that physicians vigorously oppose boxing in youth and encourage patients to participate in alternative sports in which intentional head blows are not central to the sport. *Pediatrics* 2011; 128:617–623

INTRODUCTION

Amateur or Olympic-style boxing is a collision sport that is won on the basis of the number of clean punches landed successfully on an opponent's head and body (Appendix).^{1,2} A match is won outright if an opponent is knocked out. Participants in boxing are at risk of serious neurologic and facial injuries.^{3–7} Despite these potential dangers, thousands of boys and girls participate in boxing in North America. In 2008, more than 18 000 youths younger than 19 years were registered with USA Boxing (Lynette Smith, USA Boxing, written communication, August 2009).

The societal debate regarding boxing has raged for decades. Many authors and medical organizations have called for boxing to be banned (Table 1), citing medical, ethical, legal, and moral arguments.^{8–13} Others state that participants should be allowed to make autonomous decisions about participation and that the role of the medical profession should be restricted to the provision of injury care, advice, and information only.¹⁴

Supporters of amateur boxing state that the sport is beneficial to participants by providing exercise, self-discipline, self-confidence, character development, structure, work ethic, and friendships.¹⁴ For some disadvantaged youth, boxing is a preferential alternative to gang-related activity, providing supervision, structure, and goals.¹⁴ The overall risk of injury in amateur boxing seems to be lower than¹⁵ in some other collision sports such as football, ice hockey, wrestling, and soccer.^{4,16} However, unlike these other collision sports, boxing encourages and rewards direct blows to the head and face.

TABLE 1 Position Statements on Boxing

Organization	Position
American Medical Association ⁹ (2007)	Recommends that until boxing is banned, head blows should be prohibited
American Academy of Pediatrics ⁸ (1997)	Opposes boxing as a sport for any child, adolescent, or young adult
Australian Medical Association ¹⁰ (2007)	Opposes all forms of boxing; recommends the prohibition of all forms of boxing for people younger than 18 y
British Medical Association ¹¹ (2007)	Opposes amateur and professional boxing; calls for complete ban on boxing; recommends banning boxing for those younger than 16 y
Canadian Medical Association ¹² (2002)	Recommends that all boxing be banned in Canada
World Medical Association ¹³ (2005)	Recommends that boxing be banned

The American Academy of Pediatrics and the Canadian Paediatric Society oppose boxing and, in particular, discourage participation by children and adolescents.⁸

BOXING-RELATED INJURIES

Data are limited on injuries that result from boxing in children and adolescents.^{17,18} National organizations, such as Boxing Canada and USA Boxing, do not keep data on the participation or injury rates of their members.

Some data on boxing injuries in children are available from the Canadian Hospitals Injury Reporting and Prevention Program database, maintained by the Public Health Agency of Canada. This database includes data collected from 15 hospitals across Canada, including 10 children's hospitals. From 1990 to 2007, the prevalence of injury from combat sports requiring admission to a hospital was highest for boxing (4.8%),¹⁷ which compares with admission rates of 3.6% for judo, 3.1% for karate, and 2.9% for wrestling.¹⁷ Of those hospitalized for injuries from boxing, 58% had facial fractures and 25% sustained closed head injuries.¹⁷ There was a significant increase in the overall number of injuries from 1999–2007 (16.4 in 100 000), compared with 1990–1998 (11.4 in 100 000). Sixty-eight percent of these injuries occurred during sparring and competition; the remainder oc-

curred during training. Of the 273 injured boxing athletes reported in the Canadian Hospitals Injury Reporting and Prevention Program database, fewer than 1% were 5 to 9 years of age, 29.3% were 10 to 14 years of age, 39.2% were 15 to 18 years of age, and 30.8% were 19 years of age or older.¹⁷

The National Electronic Injury Surveillance System (NEISS) contained reports of 1263 boxing-related injuries in children and adolescents 5 to 14 years of age and 8082 in adolescents and adults 15 to 24 years of age in the United States in 2007. The types and severity of injuries were not delineated.¹⁸

Published injury data in amateur boxing (youth and adult participants) do not distinguish injuries according to age, so it is difficult to delineate injuries that specifically affected children and adolescents. Most injuries in boxing, both amateur and professional, occur during competition (57%), compared with training (43%).⁴ The authors of 1 cohort study reported an injury rate of 1.0 injury per 1000 hours of participation for amateur boxers (15.1–37.1 years of age).⁴ This rate is actually lower than reported high school athlete injury rates of 4.4 per 1000 athlete-exposures in football, 2.5 in wrestling, and 2.4 in soccer.¹⁶ Intentional facial and head injuries, however, are more frequent in boxing.¹⁷

Types of Injuries

The most common injuries in boxing are to the head, face, and neck regions.^{4,5,19,20} One prospective cohort study documented that more than 70% of injuries in amateur (average age: 23.7 years) and professional boxers were to the head.⁴ Concussion was the most common injury (33%), followed by open wounds/lacerations/cuts (29%) and fractures (19%).⁴ The eyebrow and nose were other common sites of injury (19% each).⁴ Most injuries to the eye region were lacerations/cuts, although conjunctival, corneal, lenticular, vitreal, ocular papilla, and retinal lesions were also reported.⁵ Canadian Hospitals Injury Reporting and Prevention Program data are similar; one-third of the reported injuries affected the head, face, and neck regions, and almost half of the injuries occurred in the upper extremity (Table 2).¹⁷

Brain injury is the most significant risk associated with boxing, and acute subdural hematoma is the most common cause of death in amateur and professional boxers.^{5,16} Between 1918 and 1997, 659 deaths from boxing have occurred, all from catastrophic brain injury.⁶

There is evidence that amateur boxers are at risk of structural brain injuries, cognitive abnormalities, and neurologic deficits from the sport.^{7,21–25} One study of 14 amateur boxers revealed elevated levels of cerebrospinal fluid biochemical markers from neuronal and astroglial injury after bouts.²¹ Significant increases in levels of these markers were associated with multiple or high-impact hits to the head.²¹ In addition, new MRI techniques have revealed structural brain abnormalities in boxers, including microhemorrhages.²² Furthermore, electroencephalography studies have found a significantly higher incidence of abnormalities among retired amateur

TABLE 2 Boxing-Related Injuries,^a Ages 5 to 59 Years: Canadian Hospitals Injury Reporting and Prevention Program, 1990–2007¹⁷

Body Part/Nature of Injury	Sparring/Competition, <i>n</i> (%)	Conditioning, <i>n</i> (%)
Upper extremity	87 (47.0)	80 (94.1)
Fracture, dislocation	32 (17.3)	33 (38.8)
Bruise, abrasion, laceration	25 (13.5)	20 (23.5)
Soft tissue	14 (7.6)	9 (10.6)
Sprain/strain	12 (6.5)	18 (21.2)
Other (bite, nerve injury)	4 (2.2)	0 (0.0)
Head, face, neck	62 (33.5)	0 (0.0)
Facial fractures	17 (9.2)	
Closed head injuries	17 (9.2) ^b	
Facial bruise, abrasion; soft tissue	12 (6.5)	
Facial, scalp laceration	7 (3.8)	
Eye injury	5 (2.7)	
Neck sprain/strain	3 (1.6)	
Neck soft tissue	1 (<1.0)	
Trunk	19 (10.2)	0 (0.0)
Bruise, abrasion, soft tissue	13 (7.0)	
Rib fracture	3 (1.6)	
Sprain/strain	2 (1.1)	
Internal abdominal	1 (<1.0)	
Lower extremity	15 (8.1)	4 (4.7)
Sprain/strain/dislocation	6 (3.2)	1 (1.2)
Fracture/dislocation	3 (1.6)	0 (0.0)
Other (bruise, abrasion, soft tissue, nerve injury)	6 (3.2)	3 (3.5)
Other and unknown	2 (1.1)	1 (1.2)
Total	185 (100.0)	85 (100.0)

^a In 3 cases, the training type was unknown: 2 upper-extremity fractures and 1 lower-extremity soft tissue injury.

^b *n* = 10 minor closed head injuries, 6 concussions, and 1 intracranial injury.

boxers compared with active soccer players and track-and-field athletes.²³ There is also evidence of diminished neurocognitive functioning on neuropsychological tests in amateur boxers without concussions despite the use of headgear.^{23–25} The long-term significance of these findings is yet to be determined.

Concussions

Concussions in sport are a significant public health concern, and they occur frequently in boxing.^{4,7,20,25} The exact incidence of concussion in children and adolescents participating in boxing has not been published, because studies of amateur boxers do not separate data according to age. However, reports of concussions in amateur boxing range from 6.5% to 51.6% of all injuries.⁵ The authors of 1 study of amateur boxers (older than 16 years) reported that more than half of all injuries sustained in competition were

concussions (51.6%), and the incidence was 11.4 concussions per 1000 boxing exposures.^{5,20} A prospective cohort study of amateur and professional boxers revealed that 33% of all injuries were concussions.⁴ Another source cited a concussion rate in amateur boxing (age not specified) of 0.58 per 100 athlete-exposures, compared with 0.28 in hockey (males 5–17 years old) and 0.38 in high school rugby.⁷ Yet another study of amateur boxers (median age: 22 years) documented that 13% of matches ended because of concussions.²⁵

Concussions are particularly concerning in children and adolescents, because there is evidence that a child's brain is more vulnerable to injury and that recovery from concussion is prolonged when compared with adults.^{26–29} A prospective case-control study comparing neurocognitive recovery after concussion in high school

(aged 14–18 years) and college (aged 17–25 years) football and soccer athletes found that high school athletes had more prolonged memory dysfunction. Neuropsychological test values were significantly lower in concussed high school athletes than age-matched controls 7 days after injury, whereas college athletes recovered within 3 days after injury.²⁶ Another prospective case-control study in high school athletes with concussion demonstrated memory impairment up to 10 days after injury.²⁹ These findings can be extrapolated to young boxers, which suggests that they may take up to 10 days (or longer) to recover from concussions.

Return-to-play (RTP) guidelines after sport-related concussions is a particular area of controversy. The most recent guidelines proposed by the Concussion in Sport Group, and endorsed by both the American Academy of Pediatrics and Canadian Paediatric Society, recommend that an athlete who has sustained a concussion rest, both physically and cognitively, until the symptoms of concussion have resolved completely.^{28,30,31} “Cognitive rest” in children means limiting scholastic and other cognitive stressors such as text-messaging, computer work, and video games.^{28,30,31}

Because children may take longer to recover from concussions and because of the risks associated with head impact in younger athletes (ie, cerebral swelling), the Concussion in Sport Group recommends a more conservative approach to RTP decisions for children and adolescents, including no RTP the same day.³⁰ It is appropriate to extend the length of the asymptomatic rest period to ensure that symptoms have resolved completely and then allow athletes to progress through a medically supervised stepwise graded-exertion protocol (Table 3).^{28,30,31} No athlete should return to

TABLE 3 Graduated RTP Protocol (After a Sport-Related Concussion)³⁰

Rehabilitation Stage	Functional Exercise at Each Stage of Rehabilitation	Objective of Each Stage
1. No activity	Complete physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming, or stationary cycling, keeping intensity at <70% of MPPHR; no resistance training	Increase HR
3. Sport-specific exercise	Skating drills in hockey, running drills in soccer; no head impact	Add movement
4. Noncontact training drills	Progression to more complex training drills (eg, passing drills in football and ice hockey); may start progressive resistance training	Exercise, coordination, and cognitive load
5. Full-contact practice	After medical clearance, participate in normal training activities	Restore confidence and assess functional skills
6. RTP	Normal game play	by coaching staff

HR indicates heart rate; MPPHR, maximum permitted heart rate.

sport without being medically cleared by an experienced physician.^{28,30,31}

Concussion management and RTP decisions should be individualized on the basis of resolution of symptoms rather than prescribing RTP on arbitrary time frames. In particular, the current Boxing USA postconcussion boxing restriction period of 30 days or longer does not follow the latest Concussion in Sport Group guidelines (Appendix; Table 3).

Chronic Traumatic Brain Injury

The risk of chronic traumatic brain injury has been a concern of opponents of boxing. Numerous study authors have cited the risks of dementia pugilistica or chronic traumatic encephalopathy (CTE), thought to be caused by the cumulative effects of repeated blows to the head. CTE occurs in up to 20% of professional boxers.³² Most cases of dementia pugilistica occurred in the 1930s to 1950s, when boxing careers were much longer and involved more bouts.^{32,33} It is believed that the incidence of CTE will diminish in the modern era of boxing because of shorter careers, fewer bouts, and improved medical care; however, more longitudinal prospective studies are necessary to determine if there is truth to this assumption or whether other factors may play a role in changing rates of CTE.^{32,33}

Although predominantly described in boxing, chronic traumatic brain injury can be associated with any sport in which there is a risk of repetitive head blows, including soccer, football, ice hockey, and martial arts.³⁴ There is ample evidence indicating a cumulative effect from repeated concussive injuries.^{34–36} A prospective study of high school athletes compared neuropsychological evaluations of those with no history of concussion, asymptomatic athletes with 1 previous concussion, asymptomatic athletes with 2 or more previous concussions, and athletes who had sustained a concussion within the previous week. Asymptomatic athletes with 2 or more previous concussions had decreased performance on measures of attention and concentration, similar to athletes with recent concussion.³⁵ Another prospective study of high school athletes found that those with a history of 3 concussions were more than 9 times more likely than athletes with no previous concussion history to demonstrate 3 to 4 abnormal on-field markers of concussion severity, including loss of consciousness, anterograde amnesia, and confusion.³⁶ These study results raise the concern that repeated head injuries associated with boxing may similarly lead to long-lasting neurocognitive effects.

The risk of CTE for amateur boxers is believed to be lower than that for professional boxers, because amateur boxers have fewer, shorter fights. Amateur bouts last only 3 rounds, compared with up to 12 in professional boxing matches, and amateur careers tend to be shorter. In addition, amateur boxers are required to wear head guards.^{5,23,32,33,37,38} There is no evidence, however, that head guards prevent concussions, and although mouth guards are useful for protecting dentition, they also do not protect against concussion.^{25,37,39} More research is needed to determine if there is an association of CTE with amateur boxing.^{38–41}

Making Weight

Because boxing athletes participate in weight classes, part of the prebout medical examination involves weighing the athletes. Methods to maintain weight can be dangerous to young athletes. Boxers, similar to wrestlers, may use voluntary dehydration practices such as fluid restriction, diuretics and laxatives, rubber suits, and saunas and steam baths to lose weight.⁴² Weight loss by dehydration can result in decreased performance because of impaired reaction time, endurance, and strength as well as electrolyte imbalance and acidosis.⁴² Dehydration also negatively affects the acclimation process and thermoregulation during exercise. With increasing dehydration and electrolyte loss, the athlete is at risk of cramps, heat exhaustion, and heat stroke.⁴²

CONCLUSION

Despite the ongoing debate regarding boxing and clear opposition from medical associations around the world (Table 1),^{8,9–13} boxing continues to be available to youths under 19 years. Because the sport encourages deliberate blows to the head, participants are at risk of head injuries that may be cumulative

and even fatal. Pediatricians should strongly discourage boxing participation among their patients and guide them toward alternative sport and recreational activities that do not encourage intentional head injuries. For those youth who, despite education and counseling, choose to participate in boxing, appropriate medical care should be ensured by boxing organizations, including medical coverage at events, preparticipation medical examinations, and regular neurocognitive and ophthalmologic screening examinations, which should be provided by physicians who are knowledgeable about common boxing injuries and appropriate RTP guidelines after any injury.

RECOMMENDATIONS

The American Academy of Pediatrics and the Canadian Paediatric Society recommend that pediatricians:

1. vigorously oppose boxing for any child or adolescent.
2. educate patients who may be engaged in or considering engaging in boxing, as well as parents/caregivers/teachers/coaches, regarding the medical risks of boxing.
3. encourage young athletes to participate in alternative sports in which intentional blows to the head are not central to the sport, such as swimming, tennis, basketball, and volleyball.
4. advocate that boxing organizations ensure that appropriate medical care is provided for children and adolescents who choose to participate in boxing, ideally including medical coverage at events, preparticipation medical examinations, and regular neurocognitive testing and ophthalmologic examinations.

APPENDIX: DEFINITIONS ABOUT THE SPORT OF BOXING^{1,2}

Amateur boxing: A sport in which participants fight and win points for scoring

clean blows to the head and body above the belt. Matches consist of 3 or 4 rounds of 2 minutes each. No money is awarded. The age limit is a minimum of 11 years for bouts (none for training); there is no upper age limit.

Head injury management: USA Boxing organization rules state that boxers who sustain head injuries during a match are restricted from further participation. A 30-day restriction is applied if a boxer is knocked down by a blow to the head and gets up quickly, if a boxer fails to demonstrate “normal responses,” or if a boxer receives 3 standing 8-counts during a round or 4 standing 8-counts in a match because of head blows. A 90-day restriction is applied if there is a loss of consciousness up to 2 minutes or if the boxer has had a previous concussion-related restriction. A 180-day restriction is applied if there is a loss of consciousness for more than 2 minutes or a previous 90-day concussion-related restriction. During the restriction period, the boxer is prohibited from sparring and competitive boxing but not from conditioning. The boxer must be reexamined by a physician at the end of the restriction period before return. Individual teams/physicians/coaches can implement their own management system in addition to the USA Boxing restrictions.

Medical requirements: Prebout and postbout medical examinations are required for all amateur competitions; these are brief examinations to rule out acute injuries that may limit participation. Ringside physicians must be present for all matches and may stop a match at their discretion at any point during the bout.

Olympic boxing: A form of amateur boxing consisting of a single-elimination tournament in which participants compete for medals (gold, silver, bronze). Matches consist of 4 rounds of 2 minutes each.

Professional boxing: A sport in which participants fight for financial gain. Matches consist of 4 to 12 rounds of 3 minutes each. Professional boxing regulation in the United States varies according to state.

Protective equipment: Amateur boxers are required to wear a form-fitted mouth guard, a head guard, and a foul-proof cup (males) or a breast protector (females). Professionals do not wear head guards.

Rounds: Time periods of a boxing match.

Scoring (amateur boxing): Electronic scoring has been used internationally since 1992. Participants are awarded points for clean blows to their opponent. A scoring blow requires that the white part of the glove, covering the knuckles, makes contact within the target area (above the belt).

Standing 8-count: A referee can award a standing 8-count if a hard blow is landed or if a boxer seems to be outclassed. This time allows the referee to determine if the match can continue.

Weight classes: Boxers compete in classes, or divisions, based on weight.

Winning a bout (amateur):

- Win on points: the boxer with the most points wins.
- Win by retirement: if a boxer voluntarily retires the match, the opponent is declared the winner.
- Win by referee stopping the contest (RSC): a referee can stop a bout for a number of reasons:
 - RSC opponent outclassed: referee stops the bout because a boxer is outclassed by his or her opponent.
 - RSC opponent outscored: referee stops a bout because an opponent is outscored.
 - RSC head blows: referee stops a bout because of head blows. Boxers who receive an “H” are evalu-

ated by the ringside physician and issued a 30-, 60-, or 90-day restriction from sparring and competition depending on the severity of the injury. A boxer must be cleared by a physician before returning to boxing.¹⁶

- RSC injury: referee stops a bout because of injury.
- Win by disqualification: if a boxer is disqualified for dangerous or unsportsmanlike behavior, the opponent is declared the winner.
- Win by walkover: a boxer's opponent wins if a boxer fails to make weight, misses a scheduled bout, or is unable to compete because of medical reasons.
- No contest: a match that is called off for extenuating circumstances (lights fail, ring is damaged, etc).
- Winning a bout (professional): A professional boxer wins a fight by (1) knockout, (2) technical knockout, (3) decision, or (4) disqualification.
- Knockout (KO): occurs when a boxer is knocked down and does not get up within 10 seconds, as counted by the referee.
- Technical knockout (TKO): occurs when a boxer is judged physically unable to continue fighting. This

judgment can be made by the referee, the official ring physician, the fighter, or the fighter's assistants. If a boxer is knocked down 3 times in 1 round, the opponent wins on a TKO.

- Decision: results when boxers fight the scheduled number of rounds without a KO or a TKO. The winner is decided by the officials on the basis of a round- or point-scoring system.
- Disqualification: results when a boxer is disqualified for dangerous or unsportsmanlike behavior.

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