



Association of Ringside Physicians

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Editor-in-Chief, Editorial Board



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Lisa Nelson has worked in association management for over 30 years; the past 28 years with The Rees Group. She is currently the Managing Director of the Society for Clinical and Medical Hair Removal, but spent much the last 25 years working with association publications. She is the former Managing Editor for the *Journal of Cardiopulmonary Rehabilitation* and the *Annals of Behavioral Medicine*, and continues to edit and write for several association newsletters.

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From the Editor's Desk

Dear Colleagues,

It gives me great pleasure to bring to you a special supplement to Volume 4 issue 1 of the *ARP Journal of Combat Sports Medicine*. In this supplement Neidecker and Martin report on mortality data from head injury in professional boxing for the period 2000-2019. The Manuel Velazquez Boxing Fatality Collection was used by the authors to compile their data. Of the 2,077 fatalities compiled by the collection, 185 occurred from 2000-2019. Eighty-four (84) of these boxing fatalities met inclusion criteria for the authors' study. The majority of deaths occurred in the United States, likely on account of the fact that more boxing bouts occur in the United States as compared to other parts of the world. Fatalities seemed to be more prevalent in boxers with 15 or fewer career bouts as compared to boxers with more than 30 or more career bouts.

These are sobering statistics and should make everyone who is involved in combat sports to sit up and take notice. Boxing is a unique sport in that, as compared to other combat and contact sports, every punch thrown at the head is thrown with the intention of winning by causing a knock-out which is nothing but a concussive injury to the brain. The risk for acute traumatic injuries is very high. Subdural hematoma is the most common cause of boxing related mortality though bleeding may occur into other compartments of the brain such as an epidural hematoma, subarachnoid hemorrhage, intraparenchymal hematoma, and dissection of great vessels of the neck leading to a devastating stroke.

The authors' study is a timely reminder that boxing can never be made completely safe. It can though be made safer but for that to occur everyone who loves the Sweet Science needs to work together to develop standardized, evidence-based medical protocols designed to protect health of the boxers. That includes the various state athletic commissions, various sports governing bodies, boxers and their corner staff, The Association of Boxing Commissions and medical associations such as the Association of Ringside Physicians. If we all work together, we can make this sport we are all so passionate about safer. No boxer should die in vain.

Sincerely,

Nitin K Sethi, MD, MBBS, FAAN

MORTALITY RESULTING FROM HEAD INJURY IN PROFESSIONAL BOXING REVISITED: FATALITIES FROM 2000–2019

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KEYWORDS: boxing; traumatic brain injury; mortality

AUTHOR CONTRIBUTIONS: JN – methodology, data abstraction, analysis, writing; JM – writing

DISCLOSURES: N/A

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DATA SHARING STATEMENT: the author has no additional data to share.

Introduction

Dating back to ancient times, boxing continues to be one of the most popular and exhilarating sports, drawing fans from all around the world. Along with its popularity has come continual criticism due to the health risks associated with the sport. There has recently been discussion of whether boxing is ethical, with some of the world's organized medical leadership stating the sport should be banned.^{1,2} Recently, the safety and ethics of boxing came under question in 2019, as two athletes died the same week from brain injuries after professional boxing matches. Maxim Dadshev's bout was stopped by his trainer after the 11th round, as he believed the boxer had taken too much damage. Sadly, Maxim passed as a result of extensive brain injuries after being placed in a medically induced coma. Hugo Alfredo Santillan passed two days later following his match in Buenos Aires. He lost consciousness while the match was being announced as a draw and passed at the hospital from brain swelling and

cardiac arrest. The loss of these two athletes was yet another reminder of the risks the sport carries and encouraged medical professionals to continue to search for ways to make the sport safer.

There have been several studies that have revealed some of the risks associated with boxing. Findings have shown that chronic traumatic brain injury occurs in 20% of professional boxers³ and 15-40% have symptoms of chronic brain injury after retirement.² Despite our knowledge of injuries that boxers can experience, very few studies have looked at when these injuries are fatal. Subdural hematoma is the leading cause of neurological death for boxers in the acute setting.² One study conducted by Baird et al. analyzed some trends associated with boxing-related deaths from 1950-2007.² They found that 79% of deaths occurred after knockout (KO) or technical knockout (TKO), and most of these deaths occurred in the lower weight classes.² There was also a decrease in the number of fatalities in 1983 when championship bouts were

reduced from 15 to 12 rounds.² However, authors believed that this difference was more likely due to shorter careers and increased medical oversight than the reduced rounds.²

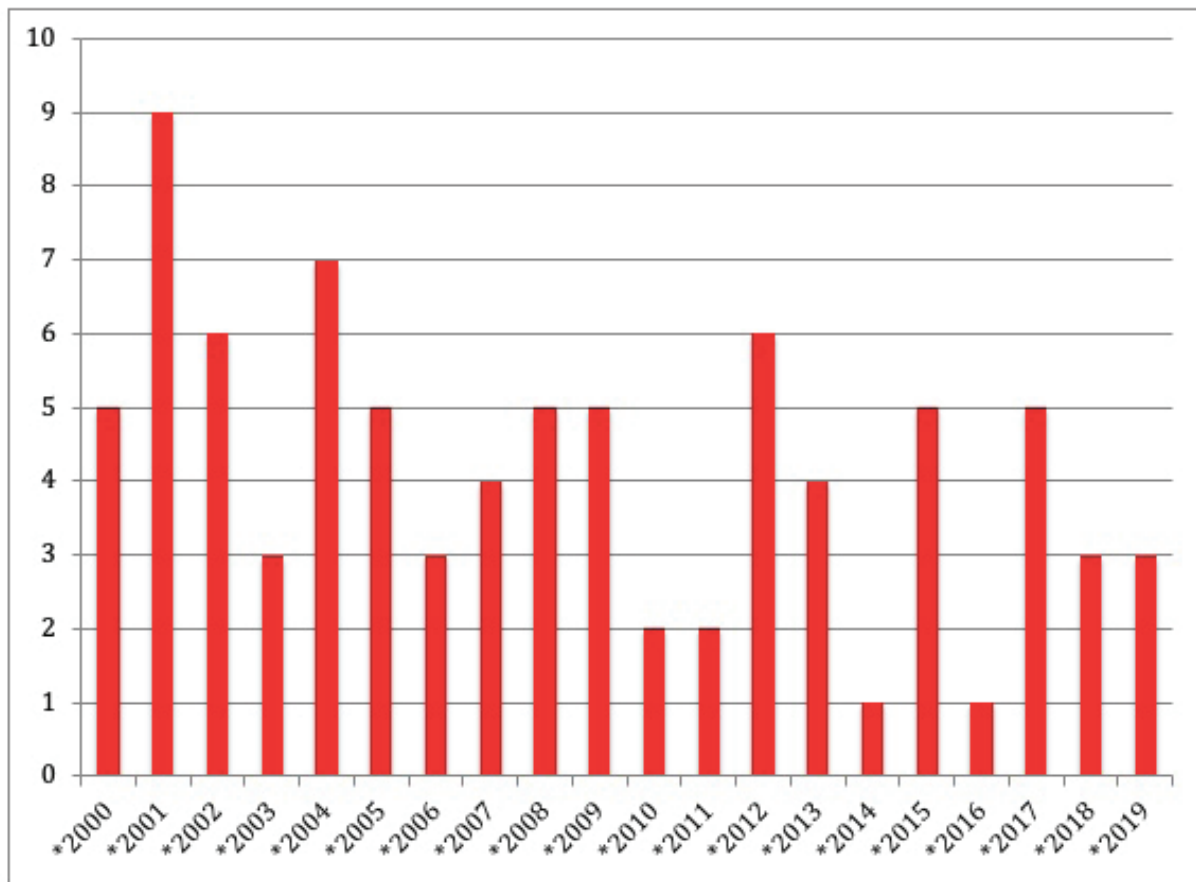
The Professional Boxing Act of 1996 established minimum health and safety standards for professional boxing, such as requiring the presence of medical personnel and a physician at all events, physical exams for all boxers, and health insurance coverage for the athletes.⁴ These requirements ensure that professional boxers are as fit to compete as possible.

With general improvements in medical knowledge/care and general increases in commission/medical combat sports oversight, the purpose of this study was to identify head injury fatality trends in professional boxing matches over the past 20 years.

Methods

Worldwide mortalities resulting from head injury in professional boxing were cataloged from 2000 to 2019. The Manuel Velazquez Boxing Fatality Collection⁵ was used to compile the catalog. Manuel Velazquez, who was an anti-boxing activist in the mid- to later 1900s, originally created the collection. Joseph R. Svinth is the current curator of Velazquez's work. He has been responsible for adding, correcting, and digitizing the collection. Baird et al. also included this collection for their data set, but at that time the collection included data until 2007.² The collection now includes a total of 2,077 fatalities occurring from 1724 to 2019. Inclusion criteria of this study were restricted to male professional boxing deaths that occurred from 2000 to 2019. Inclusion criteria were also restricted to fatalities due to brain injury and were attributed to injury sustained directly from competition. The qualifying entries of the collection

Figure 1: Professional Boxing Deaths Per Year



were then verified using BoxRec, a website dedicated to holding updated records of professional and amateur boxers.⁶ Data that remained unclear with regard to the variables or bouts that could not be verified through BoxRec were not included in the analysis. Of the qualifying fatalities, variables analyzed included age of the boxer at time of death; year of death; association with a KO/TKO/decision, win, or loss; number of rounds fought; weight class; location of bout; and winning percentage difference between the deceased and his opponent.

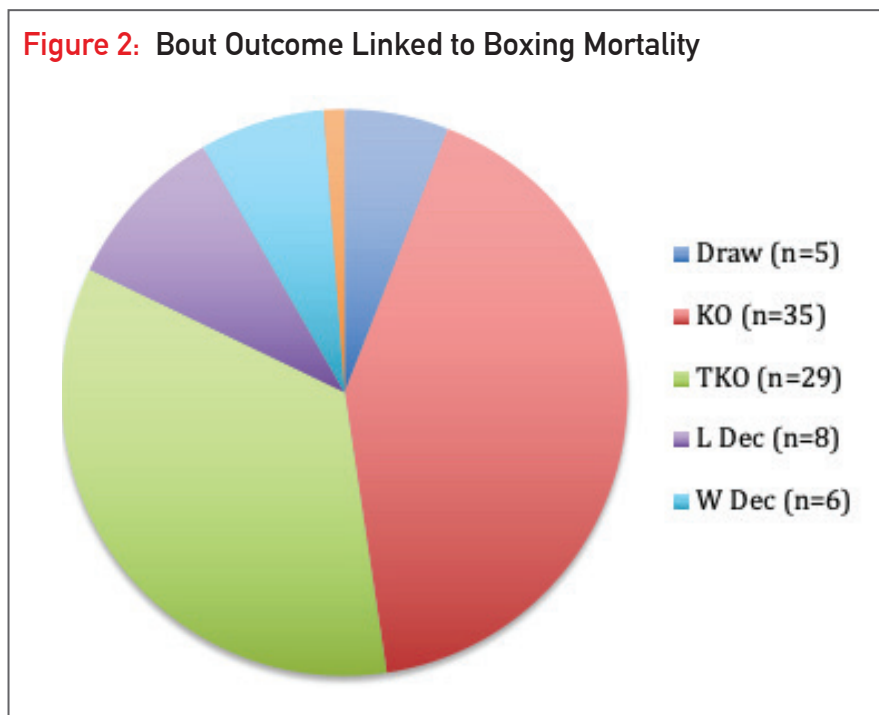
Results

Of the 2,077 fatalities compiled by the collection, 185 occurred from 2000-2019. Eighty-four (84) of these boxing fatalities met inclusion criteria for this study. Ninety (90) of the excluded fatalities involved amateur boxing (82 deaths) and toughman boxing (8 deaths). An additional eight mortalities were excluded because cause of death was sustained outside of competition in training. Five fatalities were due to non-brain injuries, four due to cardiac failure, and one renal failure. Two bouts could not be verified through BoxRec. Finally, one bout was excluded as the lone female fatality,

which was due to an intracranial bleed sustained by a super welterweight boxer after suffering a 6th round, knock-out loss in a 2014 South Africa bout.

The mean age of the boxer at time of death was 26 years old and the range was 17 to 49. BoxRec records state that a total of 428,904 professional boxing bouts occurred during the 2000 to 2019 time period.⁶ This is an incidence of approximately one brain-related fatality per 5,000 bouts. The mean fatalities per year were 4.2 from 2000 to 2019. However, fatalities seem to have decreased from 5.2 to 3.2 when comparing the 2000 to 2009 time period to the 2010 to 2019 time period respectively. (Figure 1)

41.67% of fatalities were associated with the boxer being knocked out; whereas, 34.52% followed a technical knockout loss; 9.52% followed a decision loss; 7.14% followed a decision win; 5.95% followed a draw; and 1.19% followed a win by technical knockout. (Figure 2) Approximately one-third of the KO/TKO deaths occurred in the last scheduled round of the bout. 54.69% of fatalities occurred in round 7 or later. (Figure 3) However, this finding needs to keep in context that the majority of professional boxing matches are scheduled for 4 or 6 rounds, as 8 and 10 round bouts are only scheduled if the boxers are significantly experienced. Twelve-round scheduled matches are only reserved for championship title bouts.



Evaluation of the complete series revealed mortalities in the light flyweight (8.33%), flyweight (10.71%), super flyweight (8.33%), bantamweight (5.95%), super bantamweight (8.33%), featherweight (14.29%), super featherweight (7.14%), lightweight (10.71%), super lightweight (8.13%), welterweight (4.76%), super welterweight (1.19%), middleweight (1.19%), light heavyweight (4.76%), cruiserweight (1.19%), heavyweight (3.57%) weight classes.

Figure 3: Deaths by Round

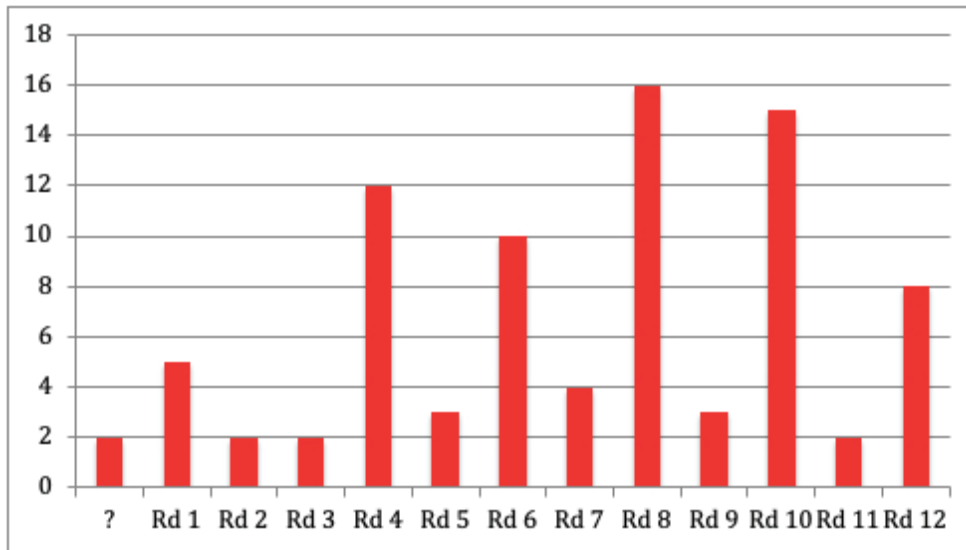


Table 1: Deaths and Bouts by Weight Class

Weight Class	Weight Limit (lbs.)	Deaths	Death %	Total Bouts	Total Bout %
Atomweight	102	0	0.00%	42	0.01%
Minimumweight	105	0	0.00%	6286	1.47%
light flyweight	108	7	8.33%	11637	2.71%
flyweight	112	9	10.71%	17070	3.98%
super flyweight	115	7	8.33%	14374	3.35%
bantamweight	118	5	5.95%	20837	4.86%
superbantamweight	122	7	8.33%	23481	5.47%
featherweight	126	12	14.29%	28664	6.68%
super featherweight	130	6	7.14%	26185	6.11%
lightweight	135	9	10.71%	35915	8.37%
super lightweight	140	7	8.33%	34512	8.05%
welterweight	147	4	4.76%	37305	8.70%
super welterweight	154	1	1.19%	30905	7.21%
middleweight	160	1	1.19%	27330	6.37%
super middleweight	168	0	0.00%	22682	5.29%
light heavyweight	175	4	4.76%	18874	4.40%
cruiserweight	200	1	1.19%	21063	4.91%
heavyweight	HWT	3	3.57%	27342	6.37%
	?	1	1.19%	24400	5.69%
Total		84		428904	

Table 2: Deaths by Country

Country	Deaths	Death %
USA	18	21.43%
Indonesia	14	16.67%
Japan	8	9.52%
South Africa	8	9.52%
Mexico	7	8.33%
Philippines	5	5.95%
Argentina	3	3.57%
Australia	3	3.57%
United Kingdom	3	3.57%
Canada	2	2.38%
South Korea	2	2.38%
Thailand	2	2.38%
Columbia	1	1.19%
Dominican Republic	1	1.19%
El Salvador	1	1.19%
Kenya	1	1.19%
Nicaragua	1	1.19%
Nigeria	1	1.19%
Panama	1	1.19%
Russia	1	1.19%
Tahiti	1	1.19%

One fatality's weight class was unknown. (Table 1) This distribution shows a higher prevalence of fatalities at the lower weight classes, with 73.81% of the deaths occurring in lightweights (135 lbs.) or lower. This is in contrast to BoxRec's records of bout distribution per weight class during the 2000 to 2019 time period, which show that 43.01% of known professional bouts occurred in the light-weight class or lower.⁶ (Table 1)

Mortality by country is noted in Table 2. The majority of deaths occurred in the United States (21.43%). However, this finding is most likely based on the increased number of bouts scheduled in the United States each year. BoxRec's records show that 19.61% of all professional boxing bouts worldwide happened within the United States during 2000 to 2019.⁶

Fatalities seem to be more prevalent in boxers with 15 or fewer career bouts with much less mortalities seen in boxers with more than 30 or more career bouts. (Table 3) However, there are not many active boxers with more than 30 career bouts when compared to their less experienced counterparts. Finally, 51% (n=39) of fatalities were associated with the deceased boxer having a worse winning percentage when compared to his surviving opponent. (Figure 4)

Discussion

Medicine continues to evolve and improve over time. Medical knowledge and treatments are exponentially improving as technology moves forward. Through legislation, medical/commission oversight in combat sports has continued to generally increase throughout the world. These advancing circumstances could be reasons why the average professional boxing neurological deaths per year has been declining each decade.

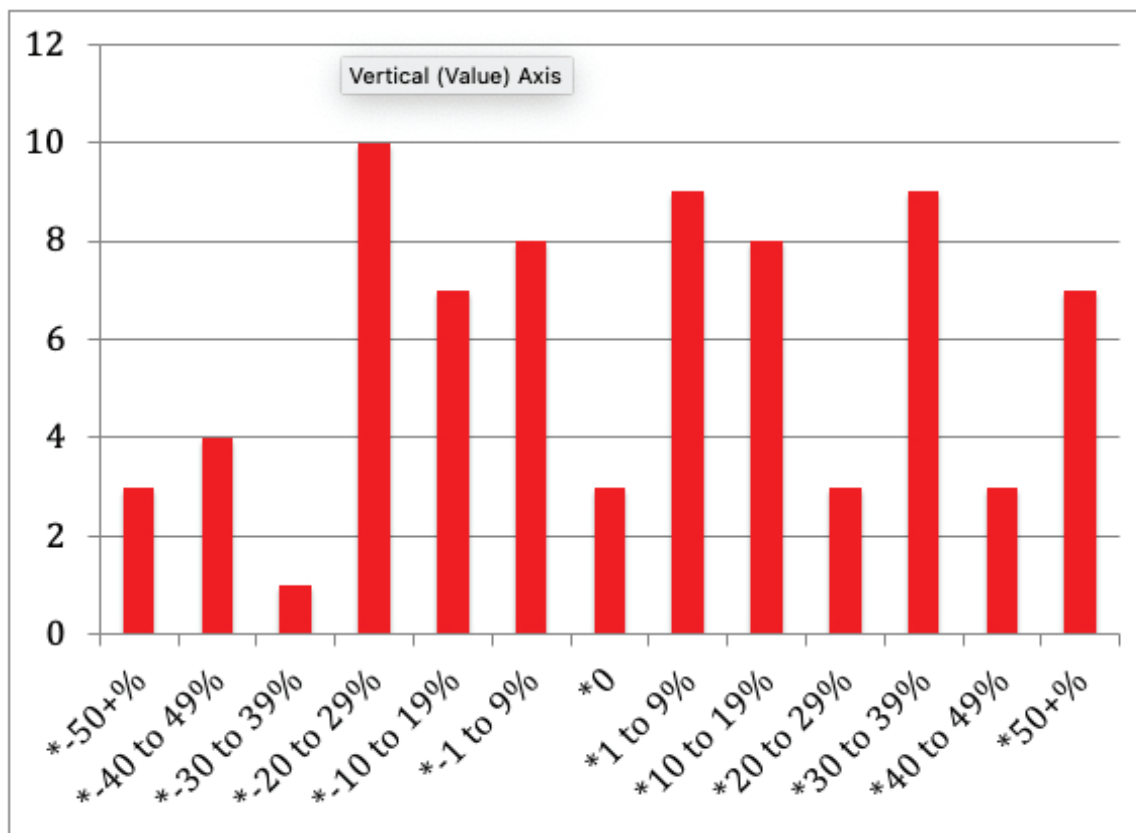
The KO is one of the most exciting moments in sports. While KOs provide excitement and entertainment, they put the athletes' health at risk. Boxing injuries occur at a higher rate in males

Table 3: Deaths by Number of Professional Career Bouts

Career Bouts	Deaths
Pro Debut	13
1 to 5	17
6 to 10	10
11 to 15	15
16 to 20	7
21 to 25	10
26 to 30	4
31 to 35	1
36 to 40	5
40+	2
Total	84

Figure 4: Winning Percentage Difference Between Opponents

**Positive difference indicates that the deceased had a worse winning percentage than his opponent. Professional debut vs. professional debut not included.*



who also have a higher rate of knockouts.^{2,7} We also found a similar trend with about 76% of the fatalities associated with a KO/TKO. In knowing this, swift action by the medical team after a KO/TKO is needed to evaluate and ensure the safety of the athlete.

Another finding of our study that is similar to the Baird et al. study was that over half of the fatalities occurred in round 7 or later.² As expected, boxers' agility and response time decreases with fatigue⁸ and are unable to avoid punches, thus taking more damage. It is reasonable to infer from this trend that repetitive head blows over the course of a bout may be a more significant risk factor for traumatic brain injury (TBI) than the one big KO punch.

Weight-classes 135 lbs. (lightweight) and lower, continue to have a higher incidence in fatality than

the heavier weight classes. Theoretical reasons of this trend include the potential increase risk of TBI in the setting of dehydration. Although there are no studies that have been shown to confirm this, it is thought by some that dehydration decreases cerebrospinal fluid and brain volume, creating a situation for a greater chance of TBI. Lighter weight class boxers in general tend to cut a higher percentage of body weight – potentially placing them at a higher risk for TBI. This theory may also give reasoning to fatalities occurring more frequently later in the bout, as boxers become more dehydrated into the deeper rounds.

The Professional Boxing Act of 1996 sought to make boxing more enjoyable for fans by ensuring the safety of the athletes. Through identifying risk factors of TBI and fatalities, physicians and referees can better protect fighters while still allowing

them to compete to the best of their ability. Boxing is an inherently dangerous sport, but as we continue to learn more about injuries and risks, we can begin to implement new standards to protect the safety of the boxers.

Limitations

The major limitation of this study is that all data are not based on medical record, but mainly based on media/commission reporting. Full details about events post-bout and medical diagnoses can be deficient in specifics and/or mistaken. Luckily this tends to be less of the case with higher-profile professional boxing than amateur boxing. BoxRec, although mostly accurate, does rely on commissions to input data into the database. Data can be inaccurate or incomplete. As more familiarity increases, recent entries into BoxRec's database are more accurate.

Another limitation of this study is that we chose to focus on mortalities and not morbidities in professional boxing. Although there are boxers who have survived an acute moderate/severe TBI, some have had to continue with the aftermath of permanent neurological sequelae from their injury. Further investigation of these injuries should be just as important as focusing on mortalities.

Conclusion

Catastrophic brain injury and death can happen at anytime in professional boxing. Although rare, the ringside physician needs to be vigilant and ready to act should these situations arise. Additionally, it is important for the ringside physician to be aware of certain situations that make boxers at increased risk for moderate/severe TBI. These risk factors include boxers who are in lower weight classes, bouts that get into the later rounds, and losing via TKO/KO.

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- Be double-spaced with 1" margins;
- Be typed in a commonly-used font (Times Roman, Helvetica, Arial, or similar), no smaller than 11 points.
- Include page numbers

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- Word count
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Electronic Journal Article

Without a Digital Object Identifier (DOI)

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With DOI:

Gage BF, Fihn SD, White RH. Management and dosing of warfarin therapy. *The American Journal of Medicine*. 2000;109(6):481-488. doi:10.1016/S0002-9343(00)00545-3.

Journal Article with No Named Author or Group Name:

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Basic science and research articles should include the following subcategories, clearly labeled in the manuscript:

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2. Introduction
3. Body
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6. Conclusion/Summary
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Case studies should include four distinct and labeled sections:

1. Introduction
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If applicable, authors must provide grant funding sources, acknowledgments, a conflict of interest statement, and the name and email address for comments. Grant funding sources should be also provided at submission and will be reported in the published paper.

Figures. Authors should construct figures with notations and data points of sufficient size to permit legible reduction to one column of a two-column page. As a guide, no character should be smaller than 1 mm wide after reduction. Standard errors of the mean should be depicted whenever possible. Rules should be at least 1/2 point. Use of shading should be limited. There are two preferred formats for electronic figures, photographs, or other artwork that accompany the final manuscript: Encapsulated PostScript (EPS) and Portable Document Format (PDF).

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