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# Care of The Older Fighter: Position Statement of the Association of Ringside Physicians

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**ABSTRACT**

Older Fighters are defined as combat sports athletes older than 35 years, based on heightened medical risks and historical classification. Age-related changes to the neurological, cardiopulmonary, endocrinological, thermoregulatory, osmoregulatory, and musculoskeletal systems increase these athletes' risks for injury and may prolong their recovery. These age-related risks warrant special considerations for competition, licensure, prefight medical clearance, in-fight supervision, post-fight examination, and counseling regarding training practices and retirement from combat sports. Neurological considerations include increased risk of intracranial lesions, intracranial hemorrhage, and sequelae from traumatic brain injury (TBI), warranting more comprehensive neurological evaluation and neuroimaging. Increased risk of myocardial ischemia and infarction warrant careful assessment of cardiac risk factors and scrutiny of cardiovascular fitness. Older fighters may take longer time to recover from musculoskeletal injury; post-injury clearance should be individualized.

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Boxing; MMA; combat sports; older athlete; high-risk combatant; medical clearance; physiological changes; neuroimaging; cardiovascular risk assessment; orthopedic injury

## Preamble: Development of these guidelines

The Association of Ringside Physicians (ARP) is an international, nonprofit organization dedicated to the health and safety of the combat sports athlete. This Position Statement represents a collaborative effort among the ARP board of directors, emeritus board, and subject matter experts from the membership. It seeks to highlight medical issues unique to older fighters in combat sports.

An extensive literature search including but not restricted to PubMed, Cochrane Reviews, and non-indexed peer-reviewed articles published in online medical journals was performed to determine the unique medical requirements of older combat sport athletes. After review, discussion, and revision, the manuscript was formally approved by the authors and the entire board of directors as the official Position Statement of the ARP.

## Introduction

Combat sports, most of which involve intentional strikes to the head and/or body, are unique in that any reduction in competitiveness also diminishes self-defense effectiveness and increases the risk of injury. Participation of athletes older than 35 to 40 years has been increasing in amateur and professional combat sports. These athletes have unique age-related physiological changes that must be taken into consideration when assessing participation in combat sports, which carry high risk of neurological, orthopedic, and other types of injuries. Therefore, regulatory bodies and physicians have sought guidance for evidence-based medical clearance and licensure to fight. This Position Statement seeks to provide the best available evidence-based guidelines to coaches, promoters, matchmakers, regulatory bodies, and medical personnel involved in optimizing the quality and safety of combat sports.

Older fighters are historically categorized as greater than 35 to 40 years of age. Only 31 state and tribal commissions in the United States specify an age threshold for certain licensing and medical oversight guidelines. Almost half use age 35 as a threshold, usually for neurological and/or cardiac issues, and rarely for ophthalmological clearance, but the range is 35 to 40 years [1]. In amateur boxing the Masters division exists for participants ages 35 and older.

For the purposes of standardization, and based on the discussion below, the ARP recommends that age 35 be considered the threshold for cardiovascular risk assessment, and age 40 be considered the threshold for neurological and other organ system risk assessment.

## Pathophysiology and Injury Epidemiology in Older Fighters

### *Neurological Issues*

There is considerable risk for acute and chronic neurological injuries in many combat sports due to repetitive strikes to the head. These repetitive head impact exposures including those

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sustained when the head strikes the canvas after a knockout or knock down can lead to acute injuries including concussion, subdural hematoma, intracranial hemorrhage, subarachnoid hemorrhage, and traumatic brain injury (TBI). Chronic injuries include chronic posttraumatic headache, chronic posttraumatic dizziness, chronic posttraumatic cognitive problems, posttraumatic seizures, posttraumatic Parkinsonism, and chronic traumatic encephalopathy (CTE). Boxing medical literature is rich with description of clinical entities such as dementia pugilistica, punch drunk syndrome, and slug nutty, all which closely resemble what is now referred to as CTE [2,3]. The true incidence of chronic neurological injuries in combat sports remains unknown as these injuries usually manifest when athletes are in their late 40's or 50's, long after they have retired. In combat sports, athletes sustain numerous head impact exposures during both training and competition. Since multiple head impact exposures are the main risk factor for CTE, the burden of this disease in combat sports athletes is likely high but has gone unrecognized or ignored by the medical profession [4]. The reason for this is that the condition comes to medical attention usually long after the athlete has retired from professional combat sports.

Vascular malformations such as aneurysms, arteriovenous malformation, cavernous malformations, and venous malformations can occur at any age but are usually discovered from age 20 to 50. These lesions are only discoverable with advanced neurological imaging (magnetic resonance imaging (MRI), or magnetic resonance angiogram (MRA)) and are usually asymptomatic but can increase the risk of intracerebral hemorrhage, especially in the setting of trauma from combat sports.

## Cardiopulmonary Issues

Cardiac aging is associated with progressive loss of myocytes and compensatory pathologic hypertrophy, and reduced response to sympathetic stimuli. These factors combine to compromise myocardial contractility and cardiac output. Several studies have demonstrated age-related changes in longitudinal shortening, systolic torsion, and cardiac energetics [5–10]. With advancing age, larger coronary arteries dilate and their walls become thicker and stiffer due to collagen and calcium deposition and fragmentation of elastic fibers [11,12]. These age-associated changes lower the threshold for cardiac ischemia, chronic heart failure, and dysrhythmia.

Coronary artery disease prevalence increases markedly after 35 years of age in both men and women leading to higher incidences of angina and myocardial infarction [13]. Furthermore, most sports-related sudden cardiac deaths (SCD) occur in athletes older than 35 years of age [14], usually caused by atherosclerotic cardiovascular disease (ASCVD). Research has found no associated plaque rupture on angiography in SCD victims with ASCVD, suggesting that sudden cardiac arrest is likely due to cardiac ischemia from oxygen supply/demand mismatch [15].

One of the most important cardiorespiratory physiological changes with advancing age is a decline in aerobic capacity – a major determinant of cardiorespiratory fitness. This decline is nonlinear and worsens progressively with each decade of life [16–18]. Maximal oxygen consumption (VO2 max, measured as milliliters of oxygen consumed per kg of body weight per minute) generally decreases about 10% per decade after the age of 25 years, 15% per decade between 50 and 70, and over 20% thereafter [15–17]. Declines in VO2 max are about 0.40, 0.39 and 0.46 ml/kg/min per year for sedentary, active and trained males, respectively and 0.35, 0.44, 0.62 ml/kg/min per year for sedentary, active and trained females, respectively [19–21]. Age-related reduction in cardiorespiratory fitness creates a double disadvantage in combat sports because, in addition to the lower competitiveness from reduced fitness, it creates a reduced ability for self-defense, leading to increased risk of serious injury.

## Endocrine Issues

Testosterone levels decline with age, falling by 1–3% per year in men starting as early as the third decade of life but usually around age 35–40 years [22–24]. Testosterone deficiency, defined as serum levels < 300 ng/dL in men, results in reduced muscle mass, reduced bone mass, and increased central body fat. In women testosterone levels begin to decrease in the fourth decade of life with up to 50% reduction at menopause. There is a direct relationship between age-related testosterone decline and decreased muscle strength mediated by sarcopenia [25].

Testosterone supplementation is prohibited in and out of competition unless there has been an approved therapeutic use exemption. Elite professional mixed martial arts (MMA) athletes abuse anabolic steroids more than any other agents, and advancing age has been shown to be associated with anti-doping rule violations [26]. It is postulated that these athletes supplement for enhanced strength, enhanced training intensity, and faster recovery from training and injury. Risks of supra-physiologic testosterone supplementation include prostate enlargement and cancer, erythrocytosis leading to deep venous thrombosis, and Leydig cell cancer [27].

## Thermoregulatory and Osmoregulatory Issues

Aging is associated with increased risk of exertional heat-related illness and decreased athletic performance in the heat. This risk is caused by several physiologic changes including reduced kidney function [28–34], reduced thirst and fluid intake, reduced sweat output [35–37], and lower heat dissipation, leading to impaired thermoregulatory function. Reduced kidney function is a result of reduced cortical mass with age [28], glomerular sclerosis [29,30], and reduced glomerular filtration rate (5–10% reduction per decade after age 35) [31–34].

## Musculoskeletal and Integument Issues

Age-related sarcopenia begins at approximately 40 years of age. Females begin earlier than males, but males suffer a greater total loss. Strength loss occurs 2–5 times more rapidly than the loss of mass [38]. With aging there is a relative increase in type I (endurance) fibers compared to the type II (power) fibers due to both atrophy and denervation [39]. Bone mass also decreases with age by about 0.3 to 0. 5% per year after peak bone mass is achieved around age 30. The rate of loss varies by skeletal region

and is influenced by genetics, nutrition, hormonal status, and habitual physical activity [40,41]. Repetitive cyclic dietary changes over consecutive competition cycles are associated with reduced bone health [42]. This is particularly notable in many combat sports where weight class requirements lead to radical dietary changes and weight fluctuations [43,44].

Tendinopathy incidence increases markedly with age, with the rotator cuff, lateral epicondyle, Achilles, quadriceps, and patellar tendons being most affected [45]. Overuse and reduced vascularity are suspected underlying causes. Ligaments such as the ACL also show microscopic degenerative changes with age, resulting in increased stiffness and reduced load capacity [46,47].

Sarcopenia and osteoporosis can lead to significant performance impairment, raising the older fighter's risk of injury. Studies have found a greater incidence of overuse injuries [48,49] and acute injuries [50] amongst the older athletes of various sports. Though evidence is still lacking, the data that is available for younger combat sport athletes also suggests that the risk is prevalent in older athletes [51].

Skin and other connective tissues deteriorate with age as well. Both intrinsic pathways such as reactive oxygen species and hormonal changes, as well as progressive extrinsic factors such as sun exposure, can damage aging skin by varying degrees [52]. The result is thinning of epidermal layers, changes in collagen, and loss of elasticity. These changes, combined with age-related atrophy of fat over the face and other locations, can pre-dispose combat sports athletes to skin lacerations.

Aging is not a predictable, linear process that manifests itself in the same way in all individuals but depends to varying degrees on an individual's lifestyle, behaviors, diet, and genetics. In particular, exercise can ameliorate some of the effects of age on muscle and bone. Regular, intense physical training by athletes over 40 contributes to the maintenance of lean mass with age [53], and participation in high-impact exercise (basketball, road race, track and field, triathlon, and volleyball) predicts preservation of bone mineral density [54]. Furthermore, weight-bearing and other activities with high-intensity loading forces in childhood and adolescence augment bone mineral accrual that persists throughout a life span [55].

In the limited literature of combat sports orthopedic injuries, age has not yet been associated with higher incidence of injury. A review in 2008 found that across 1270 MMA fights a competitor's age was not significantly associated with higher injury rates (OR 1.02, 95% CI 0.99–1.06). Rather, increased number of rounds and match losers specifically were associated with higher injury rates [56]. Another study found that in karate, judo and kickboxing athletes, having over 3 years of experience in the sport correlated better with skill in those sports, including defensive skill. They postulate that the experience that comes with age in combat sports athletes may ameliorate the risk of injury [57]. Other studies in MMA [58,59], boxing, karate, taekwondo, judo and kickboxing [60] found that weight class, not age, is associated with injury rate.

In a study by Lystad (2015), a sample that consisted of 481 unique fighters competing across 57 events, 976 athlete-exposures, 9562 minutes of exposure, and 380 injuries found that the ratio of injury incidence rates of heavy weights relative to middle weights is 1.40 (CI 1.13–1.75) and heavy weights relative to light weights is 1.82 (CI 1.35–2.45) [59].

In Sifuentes-Cervantes et al., 2021, a sample of 259 fighters (92% male) found that male weight divisions with the longest medical suspensions were the light heavyweight (110.68 days) and welterweight (108.25 days) ($p < .10166$) [60].

Studies of maxillofacial trauma in MMA fighters have found that lower weight classes [61] and lack of high-quality mouth guards [62,63] are associated with increased injury incidence, not age. Hand and wrist injuries in combat sports athletes also have no apparent relationship with age [64].

## Medical and Administrative Recommendations for Older Fighters (see Table 1 for summary)

### *Neurological Recommendations*

As discussed in detail in a separate Neuroimaging Position Statement by the ARP [65], MR-Angiogram and MRI of the brain with susceptibility weighted imaging (SWI) or gradient echo imaging (GRE) are recommended in athletes over 40 to

**Table 1.** Recommendations for care of the older fighter (age 35–40 and older) from the Association of Ringside Physicians.

(1) Medical clearance of older athletes for combat sports should be done in the context of their current medical status and physical conditioning, regardless of past athletic achievements.
(2) Neurological recommendations for athletes 40 and older:
   a. MR-angiogram (or CT-angiogram) and MRI of the brain with susceptibility weighted imaging (SWI) or gradient echo imaging (GRE) are recommended at initial licensure. When MRI is not feasible, CT-angiogram is acceptable.
   b. MRI (or CT-angiogram) is recommended every 3 years following licensure, and when clinically indicated.
   c. Neuropsychological evaluation is recommended at initial licensure and every 3 years thereafter, and when clinically indicated.
   d. Refer athletes to a neurologist or neurosurgeon with TBI experience if there is concern for neurocognitive decline.
(3) Cardiovascular recommendations for athletes 35 and older:
   a. Annual medical screening should include the AHA 14-point cardiovascular evaluation.
   b. ECG is recommended at initial licensure and annually for athletes 35 and older.
   c. Blood pressure greater than 160/100 mm Hg is disqualifying from vigorous exercise and competition until better controlled.
   d. If any other cardiovascular concerns are raised from history, physical examination, or ECG, athletes should be referred to a cardiologist for additional testing and medical clearance.
(4) Orthopedic recommendations:
   a. Older athletes should be encouraged to reacquire a high level of muscular strength and endurance before being encouraged to compete in combat sports.
   b. Athletes with osteoporosis should be discouraged from combat sports competition.
(5) Endocrine recommendations:
   a. Athletes using testosterone supplementation should be monitored for therapeutic levels and adverse effects and be counseled on the adverse effects of supraphysiologic dosing.
(6) Thermoregulatory recommendations:
   a. Athletes should be closely observed during training for signs of heat illness and be encouraged to rehydrate regularly.

detect asymptomatic micro- and macro-hemorrhages and low-flow vascular malformations. These are recommended at initial licensure. MRI with the above sequences is also recommended every three years, and when clinically indicated by injury. When MRI is not feasible, either due to non-availability or medical contraindications, a computed tomography of the brain with and without intravenous contrast (CT angiogram) may suffice with the knowledge that it has slightly lower sensitivity. The average competitive combat sports athlete has a professional career that spans approximately 10 years. The 3-year frequency of imaging ensures that the athlete gets imaged at least twice during the years of competition in addition to imaging at initial licensure [65].

Neuropsychological (neurocognitive) evaluation is recommended for combat sports athletes over 40 at the time of initial licensure and every 3 years thereafter. Testing may be requested earlier on a case-by-case basis in athletes with a history of TBI. Neuropsychological evaluation is a valuable tool to characterize, quantify, and prognosticate cognitive, behavioral, and emotional sequelae after TBI. The every-3-year testing recommendation promotes timely counseling of athletes on when to retire from combat sports. Formal testing by a neuropsychologist (pen and paper testing) or with validated computerized systems such as ImPACT is recommended. For non-English speaking athletes, interpreter mediated testing or testing in native language is acceptable [66]. If there is any deterioration from the baseline assessment, this should be discussed with the athlete [65].

If neurological decline is identified or suspected, the athlete should be temporarily suspended from competition and referred to a neurologist or neurosurgeon with TBI experience for detailed evaluation, which may include advanced neuroimaging modalities such as positron emission tomography (PET) scan and radionuclide dopamine transporter scan (DaTscan). Based on the results of these additional tests, the athlete may either be denied licensure and be counseled to retire, or they may be allowed to continue fighting under close medical supervision [67].

Close in-fight supervision is indicated for combat sports athletes of any age. An athlete who has suffered multiple head impacts and has progressive headache, focal neurological deficit, deteriorating mental status, persistent vomiting, seizures, or Glasgow Coma Scale score < 13 should be transported by ambulance to the nearest trauma center with CT capability for urgent CT of the head [68]. Athletes who have a non-urgent concussion or have lost by knockout (KO) or technical knockout (TKO) due to head blows should be administered a period of medical suspension. The goal is to give the athlete sufficient time to fully recover from the concussion prior to further sparring and return to competition. The period of medical suspension is not standardized across the many regulatory commissions in the United States and abroad [69]. It is unclear at present whether an older fighter needs a longer suspension to recover from a concussion. The duration of medical suspension should be individualized such that recovery is documented prior to clearance for training and competition. Management of concussion in combat sports and return to competition guidelines are discussed in greater detail in a separate Consensus Statement by the ARP [70].

## Cardiovascular Recommendations

Pre-fight clearance for a combat sports athlete begins with a thorough cardiovascular medical history, assessment of risk factors, and a physical examination. These should include the 14-point evaluation recommended by the American Heart Association (Table 2), which includes 10 questions about symptoms and medical history and four items on physical examination. Any significant abnormalities should be further evaluated by cardiology prior to medical clearance. Persistent hypertension of 160/100 mmHg or greater – either at the licensing physician or immediately prior to competition – should preclude further participation in high-intensity exercise or competition, regardless of age. This is based on recommendations from the Association of Ringside Physicians, the American College of Sports Medicine, the American College of Cardiology, and the American Heart Association [71]. With lesser degrees of hypertension, there is generally no need for further testing beyond the routine evaluation. However, it has been suggested that all hypertensive patients who are planning to engage in high or very high-intensity exercise (intensity ≥60% VO2 reserve) should, at the very least, undergo a medically supervised peak or symptom-limited exercise test with ECG monitoring [72].

**Table 2.** American Heart Association's 14-point Cardiovascular Evaluation.

| |
|---|
| **Personal Medical History** |
| 1. Exertional chest pain/discomfort |
| 2. Exertional syncope or near-syncope |
| 3. Excessive exertional and unexplained fatigue; fatigue associated with exercise |
| 4. Prior recognition of a heart murmur |
| 5. Elevated blood pressure |
| 6. Prior restriction from participation in sports |
| 7. Prior testing for the heart ordered by a physician |
| **Family Medical History** |
| 8. Premature death-sudden and unexpected before age 50 due to heart disease, inone or more relatives |
| 9. Disability from heart disease in a close relative < 50 |
| 10. Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome or other ion channelopathies, Marfan syndrome, or clinically important arrhythmias |
| **Physical exam** |
| 11. Heart Murmur-exam supine and standing or with Valsalva, specifically to identify murmurs of dynamic L ventricular outflow tract obstruction |
| 12. Femoral pulses to exclude aortic stenosis |
| 13. Physical stigmata of Marfan syndrome |
| 14. Brachial artery blood pressure (sitting, preferably taken in both arms) |

A screening ECG is recommended for athletes 35 years or older at initial licensing and annually. ECG has been shown to be more sensitive than history and physical exam in screening for asymptomatic cardiac disease in young athletes, and since the incidence of cardiac disease is higher with advancing age, ECG screening is prudent in older athletes [73]. Furthermore, the ECG should be interpreted using international criteria established specifically for athletes [74]. Any significant abnormalities based on this interpretation should be further evaluated by cardiology prior to medical clearance.

Athletes over 40 should also ideally have a 10-year Atherosclerotic Cardiovascular Disease (ASCVD) risk score calculated to further determine the risk of ASCVD [75]. Though this is not a firm requirement prior to licensing, it can be helpful for athletes and their primary care physicians in prevention of ASCVD. A score of < 5% indicates low risk of ASCVD in the next 10 years. In the absence of symptoms, an ASCVD score over 5% warrants management of modifiable ASCVD risk factors (blood pressure, hyperlipidemia, diabetes mellitus, etc.). In the presence of cardiovascular symptoms, further evaluation by a cardiologist is indicated prior to medical clearance.

### *Orthopedic Recommendations*

Although aging adversely affects bone density, muscle strength and volume, and tendon and ligament strength, as discussed above, there do not appear to be compelling differences in injury rates in older athletes to warrant specific age-related recommendations at this time. While regular intense exercise lessens the decline in strength and bone mass with time, lack of exercise for prolonged periods will allow these changes to occur unchecked. Therefore, prolonged periods of inactivity in older fighters warrants some scrutiny. In this case, wise coaching and careful matchmaking are prudent. Older athletes should be encouraged to reacquire a high level of muscular strength and endurance before being encouraged to compete in combat sports. Their physicians should optimize their bone health with vitamin D and calcium supplementation, if indicated, and treatment of osteoporosis if present.

Athletes with osteoporosis should be discouraged from combat sports competition but encouraged to engage in strength and weight-bearing sports and exercise in order to maintain bone mass.

### *Endocrine Recommendations*

Older athletes should be counseled by their coaches and physicians on the adverse effects of supra-physiologic testosterone supplementation, if this is known or suspected. Regular monitoring of serum testosterone concentration in athletes doing testosterone replacement therapy should assure levels are within physiologic limits and that erythrocytosis and elevation of prostate specific antigen (PSA) are not developing. Therapeutic Use Exemptions (TUE) are required for all anabolic steroid use in national and Olympic athletes and some professional combat sports organizations. These athletes' physicians should become familiar with the TUE process and support these athletes in meeting their oversight requirements.

### *Thermoregulatory and Osmoregulatory Recommendations*

Due to disordered thermoregulation and reduced thirst drive, older athletes should be closely observed during training for signs of heat illness. They should be encouraged to drink slightly more water or sports drink than their thirst suggests.

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