**Commentary**

# Ensuring and maintaining brain health of the combat sport athlete

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WORD COUNT=752 words, KEY WORDS: boxing; MMA; combat sports; neurological injuries; traumatic brain injury; TBI; brain fitness; brain health

AUTHOR CONTRIBUTIONS: NKS conceived, drafted and revised the manuscript.

STUDY FUNDING: No targeted funding reported.

DISCLOSURES: NKS serves as Associate Editor, The Eastern Journal of Medicine and Editor-in-Chief, ARP Journal of Combat Sports Medicine. He also serves as Chief Medical Officer of the New York State Athletic Commission (NYSAC). The views expressed are his and do not necessarily reflect the views of the NYSAC.

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

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Combat sports such as professional boxing and mixed martial arts (MMA) are popular sports with high risk for both acute and chronic traumatic brain injuries (TBI). Unfortunately, combatants have died in the ring or soon after the completion of a bout usually due to an acute catastrophic neurological event such as an acute subdural hematoma (SDH); which has been documented to be the most common cause of boxing related mortality. Acute TBI is just the tip of the iceberg when it comes to neurological injuries caused by combat sports. Hidden under the surface and away from the eyes of the public and media are the equally devastating chronic neurological sequelae of boxing and MMA including but not limited to chronic posttraumatic headache, chronic posttraumatic dizziness, posttraumatic cognitive impairment, posttraumatic Parkinsonism, posttraumatic dementia, dementia pugilistica, punch drunk syndrome, chronic traumatic encephalopathy (CTE) and neuropsychological sequelae such as mood, behavioral changes and depression.

At present there are no validated imaging or bio fluid (blood, cerebrospinal fluid) biomarkers for concussion and many of the above chronic neurological sequelae of boxing and MMA. In the absence of biomarkers; prognostication of the brain health of a combat sports athlete is inherently difficult. Most combatants undergo neuroimaging at the time of applying for initial licensure to compete in combat sports. This entails a magnetic resonance (MRI) scan of the brain without contrast usually carried out on a 1.5 or 3 Tesla strength magnet. In some countries and Commissions in the United States, a computed tomography (CT) scan of the head is acceptable in lieu of the MRI brain. While neuroimaging prior to licensure helps detect incidental clinically silent structural lesions with a high risk of bleeding such as aneurysm, arteriovenous malformation, large cavernoma, vein of Galen malformation and brain tumors, it does not yield any useful information about the function of the brain. Hence combining structural imaging with a functional study of the brain such as a formal neurocognitive evaluation should be considered at the time of initial licensure. Neurocognitive testing is a way to measure brain function non-invasively. It uses paper-and-pencil tests or computerized tests to assess important aspects of cognition such as attention, memory (immediate recall, short-term, long-term, auditory, visual), language, reaction time, perception and so on after factoring in the IQ and formal education of the examinee. A formal neurocognitive evaluation carried out by a qualified neuropsychologist is extremely helpful to formally assess the function of the brain as well as the mind and to grade/score it. The above test combo carried out at the time of the initial licensure serves as the baseline against which future test results are compared.

The average professional career of a combat sports athlete spans 10 years. During their active career most combatants fight on an average 2-6 times per year. It is recommended that a combat

sports athlete undergo repeat MRI brain and neurocognitive evaluation after every 3 years. If the MRI shows evidence of prior TBI such as an area of encephalomalacia or gliosis, diffuse axonal injury, micro hemorrhages and the neurocognitive scores show a demonstrable decline, the combatant should be flagged. These combatants may need further tests such as PET scan of the brain, an electroencephalogram (EEG) and referral to a neurologist. On a case by case some may be allowed to proceed with their career under close observation while others may be counseled to hang up their gloves in order to prevent further and at times irreversible brain damage.

The brain is like a muscle and needs to be exercised, nourished and nurtured. The more it is exercised the stronger it becomes. *Use it or lose it* has scientific validity. Combat sports athletes should be counseled about brain health and how to build their cognitive reserve by doing exercises such as crossword puzzles, playing chess, reading, writing, listening to music or learning a new language or musical instrument. Supplements such as magnesium oxide and vitamin B12 are generally acknowledged to be brain healthy. A brain healthy Mediterranean diet which entails cooking food in extra virgin olive oil, less of dairy, less of red meat, more fish, more nuts should be promoted.

It is further recommended that the various sports commissions in the United States and abroad and combat sport's governing bodies coordinate to assist with the setting up of an online central neuroimaging and neurocognitive database so that neuroimaging and neurocognitive data can be shared in the different countries where the combatant may compete.

The above interventions shall help to maintain the brain health of the combat sports athlete.

Reference

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