J Exp Neurol. 2022;3(1):20-23.

Journal of Experimental Neurology Commentary

In the Mind of the US Olympic Athletes; Longevity Advantage and Its Relation to Nervous System Disorders and Mental Illness

Moi Yamazaki[1*], Jean-François Toussaint[1,2], Juliana Antero[1]

[1]Institut de Recherche bioMédicale et d'Epidémiologie du Sport – URP 7329, INSEP - Université Paris Cité – Paris, France

[2]Centre d'Investigation en Médecine du Sport, Hôtel-Dieu, Assistance Publique - Hôpitaux de Paris, Paris, France

[*]Correspondence should be addressed to Moi Yamazaki, yamazakim@alumni.beloit.edu; moi.yamazaki@inserm.fr

Received date: March 16, 2022, **Accepted date:** April 14, 2022

Citation: Yamazaki M, Toussaint JF, Antero J. In the Mind of the US Olympic Athletes; Longevity Advantage and Its Relation to Nervous System Disorders and Mental Illness. J Exp Neurol. 2022;3(1):20-23.

In a recent study of 8124 US Olympic athletes, Antero et al. [1] found that the US Olympic athletes live 5 years longer than their general counterparts. This longevity advantage was mainly driven by the lower risk of the major two causes of death, i.e. cardiovascular diseases and cancer. This survival advantage spared elite athletes and saved a large and significant amount of life compared to their counterparts in the general population.

However, the study also reported that the athletes did not benefit from such an advantage when it comes to death due to nervous system disorders (e.g., Alzheimer's and Parkinson's diseases) and mental illnesses (e.g., dementia, schizophrenia). This raises a critical question as to what could be the driving causes of such a disruption in their longevity advantage [1].

One possibility is that Olympic athletes are also exposed to specific risks that may damage their nervous system and mental health to the point it diminishes the advantage they could have had, would they have not been exposed to such risks. This commentary explores potential risks elite athletes may be exposed to, regarding nervous system disorders and mental illness, despite their longevity advantage based on similar studies using the same cohort of the US Olympic athletes, the biggest cohort of athletes sent since the modern Olympic Game.

Nervous System Disorder

A brain injury may result in sustained neuroinflammation, and accelerating age-related neurodegeneration, ultimately leading to death [2-4]. Repeated traumatic brain injuries as the result of detrimental shock to the head while playing sports. These are associated with the development of neurodegenerative diseases (e.g., Alzheimer's and Parkinson's disease; nervous system disorder) [5,6].

The occurrence of sports-related traumatic brain injury (TBI) is understood to be different across different sports. Among collegiate level athletes, higher incidence of TBI are reported from sports where a frequent and high-grade collision occurs, such as American football and Ice hockey [7,8]. Meanwhile, the incidence is low among sports where athletes come in a less frequent collision and less impact to the head, such as baseball and volleyball [7].

To support this, a higher neurodegenerative mortality rate is reported among former American football players as well as Finnish boxers [9,10]. In one study, it was revealed that National Football League players observed three-times higher neurodegenerative mortality compared to Major League Baseball players [11]. This study suggests that not only the occurrence but also the severity of sports-related brain injury differs by sports. Interestingly lower overall mortality rates were found among the cohort of soccer players. The lower mortality found, similarly to US Olympians, was mainly driven by a diminished mortality due to cardiac and cancer diseases, highlighting specific neurological death risks within a population that outlive their referents in the general population [12].

Using the same cohort of former US Olympic athletes as the focal article, the impact of a repeated shock to the head by sports and its relation to neurodegenerative mortality was recently explored in the study done by Yamazaki et al. [13]. This study revealed that compared to the athletes who

participated in sports where the repeated shock to the head is presumably the lowest (e.g. swimming and athletics), athletes who engaged in sports with the highest presumed risk (e.g. collision sports such as boxing, rugby and ice hockey) had three times higher rate of neurodegenerative death [13]. The authors also found that the athletes in collision sports - the most exposed to repeated shocks to the head - lost small yet noteworthy years of life (-0.6 year, CI95: -1.16 to -0.06) from neurodegenerative diseases when compared to the general population. Conversely, the athletes enduring a moderate to the lowest risk gained 0.4 (CI95: 0.26 to 0.54) to 0.09 (CI95: -0.09 to 0.28) year until age 90 only from avoiding neurodegenerative deaths [13]. The study concluded that the risk exposure to repeated shocks differs by sports events; collision sports having worse consequences, since this risk may partially jeopardize the longevity advantage that top-level athletes benefit.

The potential consequences of repeated shocks on the head may go beyond nervous system; it is also associated with mental health issues in the long-term Kerr et al. [14]. found that the prevalence of depression was 2.4 times higher among the retired collegiate level athletes whom reported more than three concussions (as the result of significant shock on the head while playing sports) during their career than those reported zero [14]. Another study reported the risk of manifesting a form of common mental disorders (e.g. anxiety and depression) was 5.2 times higher among professional male rugby, ice hockey, and soccer players reporting six or more concussions during their career compared to those with no such harm [15]. Similar results were obtained from the German female professional soccer players [16].

Mental Illness

Severe mental illness is associated with premature death [17]. People suffering from severe mental illness tend to be physically inactive, smoke, binge drink, and may experience side effects of psychiatric medications that make them more vulnerable to cardiovascular, respiratory and infectious diseases, diabetes, and hypertension as well as suicide [17,18]. A Danish study sampling the general population, reported that the life expectancy of those diagnosed with any mental disorder was shortened by 7.9 (female) to 11.2 (male) years [19]. The study also reported that two major mental disorders contributed a striking life-years loss; 6.4 (female) to 8.3 (male) years from major depressive disorder, and 6.3 (female) to 7.5 (male) years from anxiety disorders [19].

Chronic psychological stress can lead to developing mental illness [20]. Olympic athletes are likely to be exposed to high-level pressure to excess fear of failing, while expected to be tough and resilient [21]. In addition to such stresses, additional stresses can contribute to developing mental disorders. The prevalence of eating disorders is higher in sports that require athletes to remain in lean body shapes, such as figure skating [21].

Combined with poor coping strategies, athletes are not strangers to mental illness. Furthermore, changes athletes face upon retirement may prolong or even worsen such conditions [21]. One study reported that as high as 46.4% of Australian athletes (N = 224; a mixed sample) met the clinical cut-off for a diagnosable mental health disorder [22]. The mental ill-health of athletes may be severe enough to diminish their longevity advantage.

To examine the potential association, Duncombe et al. [23] also investigated former US Olympians where they found a 32% reduction in mortality rate from any mental disorders, when compared to the general population. This resulted in a gain of 0.21 (CI95: 0.14 to 0.29) year of life from avoiding death due to self-harm, anxiety, and depression, and 0.12 (CI95: 0.08 to 0.15) year from avoiding death due to substance abuse and eating disorders if the Olympians had perceived the same mortality rate of the general population [23].

Neurodegenerative diseases greatly decrease the quality of life of those affected; the diseases' slow yet inevitable progression that results in loss of physical and cognitive function creates a profound psychological distress [24]. Indeed, depressive symptoms are frequently observed in populations with neurodegenerative diseases, which put them at higher risk of suicide [24,25]. In some studies, such an elevated risk is reported to be as high as 20 times, compared to the general population [24,26]. Based on these observations as well as the findings of the Yamazaki study, higher mortality rate and loss in years of life from mental illness could be expected in the US Olympic athlete cohort, yet, such an association was not found in Duncombe paper, and was not explored in Yamazaki paper. To the best of our knowledge, there are no reported associations between neurodegenerative disorders and incidence of suicidality among elite athletes.

All three articles analyzed here emphasize the lack of data and studies on the longevity of female athletes in particular. Indeed, it is one of the biases which may be hindering the true impact of certain sports risks that negatively affect high-level athletes' longevity advantage. Female athletes represent no more than 30% of the Olympic athlete cohorts from other longevity studies around the world and are responsible for an even smaller proportion of deaths, or not included in the cohort at all [13,23,27-32].

Multiple studies have reported that higher incidence and prevalence rates are observed in both sports-related traumatic brain injury and mental illness among female athletes [7,22,33]. Thus, having a larger number of female athletes in the cohort is especially important in this context. We hence encourage future studies to have larger cohorts of female athletes in order to understand the trend in cause-specific mortality and overall longevity.

Nevertheless, the focal article and the Yamazaki paper together highlight the potential permanent damage on

nervous system disorders in collision sports. This brings a great significance into the field of sports from the perspective of public health. It raises the concern of long-term consequences of repeated shocks on the head that occur during practice and matches in underrepresented sports such as judo for example. This commentary thus calls for scientists, policymakers, and those involved in sports to come together, encourage clinical studies and implement evidence-based prevention guidelines as well as protocols to protect athletes, elite and non-elite, from damaging effects.

At last, driving causes of disruption in cause-specific longevity advantage of the US Olympic athletes remain under-investigated. It was hypothesized that certain risks associated with nervous system disorders and mental illness may be severe enough to cause such a disruption. By analyzing two additional studies investigating the cohort of US Olympic athletes, two propositions can be made: 1) the diminished longevity advantage from nervous system disorders could be associated with the repeated shocks to the head while playing sports where high-grade collision frequently occur, and 2) the risk factors of developing mental illness may however not have enough magnitude to disrupt the global advantage elite athletes benefit as a defined population. Future studies should focus on larger cohorts of female athletes. and safer practices to protect athletes from collisions sports from long-term consequences should be encouraged. In addition to safer practices, routine screening of sports-related TBI and the provision of proper care are recommended. The recent death of Aaron Hernandez, an NFL player, and a murder convict, brought public attention to the enormity of repeated shock to the head while playing sports. Posthumously, Hernandez was diagnosed with Chronic Traumatic Encephalopathy, a neurodegenerative disease likely caused by repetitive head trauma associated with cognitive impairment, behavioral change (violence in particular), mood disorders as well as dementia-like symptoms [34,35]. Future studies should pave a way to better understand the causalities of these kind of sequels. Although such a case may be an extreme end of the manifestations of a repetitive shock to the head while playing sports, the long-term consequences, in terms of risk of neurodegenerative death exists. Participation in sports is encouraged for healthy living, so should be a safe practice.

References

1. Antero J, Tanaka H, De Larochelambert Q, Pohar-Perme M, Toussaint JF. Female and male US Olympic athletes live 5 years longer than their general population counterparts: a study of 8124 former US Olympians. British Journal of Sports Medicine. 2021 Feb 1; 55(4):206-12.

2. Sahler CS, Greenwald BD. Traumatic brain injury in sports: a review. Rehabilitation Research and Practice. 2012 Oct;2012.2012:659652.

3. Faden AI, Loane DJ. Chronic neurodegeneration after traumatic brain injury: Alzheimer disease, chronic traumatic encephalopathy, or persistent neuroinflammation?. Neurotherapeutics. 2015 Jan;12(1):143-50.

4. Papa L, Ramia MM, Edwards D, Johnson BD, Slobounov SM. Systematic review of clinical studies examining biomarkers of brain injury in athletes after sports-related concussion. Journal of Neurotrauma. 2015 May 15;32(10):661-73.

5. Peskind ER, Brody D, Cernak I, McKee A, Ruff RL. Military-and sports-related mild traumatic brain injury: clinical presentation, management, and long-term consequences. The Journal of Clinical Psychiatry. 2013 Feb 15;74(2):11946.

6. Crane PK, Gibbons LE, Dams-O'Connor K, Trittschuh E, Leverenz JB, Keene CD, et al. Association of traumatic brain injury with late-life neurodegenerative conditions and neuropathologic findings. JAMA Neurology. 2016 Sep 1;73(9):1062-9.

7. Daneshvar DH, Nowinski CJ, McKee AC, Cantu RC. The epidemiology of sport-related concussion. Clinics in Sports Medicine. 2011 Jan 1;30(1):1-7.

8. Chandran A, Boltz AJ, Morris SN, Robison HJ, Nedimyer AK, Collins CL, et al. Epidemiology of Concussions in National Collegiate Athletic Association (NCAA) Sports: 2014/15-2018/19. The American journal of sports medicine. 2022 Feb;50(2):526-536.

9. Lehman EJ, Hein MJ, Baron SL, Gersic CM. Neurodegenerative causes of death among retired National Football League players. Neurology. 2012 Nov 6;79(19):1970-74.

10. Kettunen JA, Kujala UM, Kaprio J, Bäckmand H, Peltonen M, Eriksson JG, et al. All-cause and disease-specific mortality among male, former elite athletes: an average 50-year follow-up. British Journal of Sports Medicine. 2015 Jul 1;49(13):893-7.

11. Nguyen VT, Zafonte RD, Chen JT, Kponee-Shovein KZ, Paganoni S, Pascual-Leone A, et al. Mortality among professional American-style football players and professional American baseball players. JAMA Network Open. 2019 May 3;2(5):e194223.

12. Mackay DF, Russell ER, Stewart K, MacLean JA, Pell JP, Stewart W. Neurodegenerative disease mortality among former professional soccer players. New England Journal of Medicine. 2019 Nov 7;381(19):1801-1808.

13. Yamazaki M, De Larochelambert Q, Sauliere G, Toussaint JF, Antero J. Heads-Up: Risk-Specific Neurodegenerative Mortality and Years-Saved Analysis on the US Olympian Cohort. Frontiers in Physiology. 2021 Sep 9;12:705616.

14. Kerr ZY, Evenson KR, Rosamond WD, Mihalik JP, Guskiewicz KM, Marshall SW. Association between concussion and mental health in former collegiate athletes. Injury Epidemiology. 2014 Dec;1(1):28.

15. Gouttebarge V, Aoki H, Lambert M, Stewart W, Kerkhoffs G. A history of concussions is associated with symptoms of common mental disorders in former male professional athletes across a range of sports. The Physician and Sports Medicine. 2017 Oct 2;45(4):443-449.

16. Prien A, Feddermann-Demont N, Verhagen E, Twisk J, Junge A. Neurocognitive performance and mental health of retired female

football players compared to non-contact sport athletes. BMJ Open Sport & Exercise Medicine. 2020 Dec 1;6(1):e000952.

17. De Mooij LD, Kikkert M, Theunissen J, Beekman AT, De Haan L, Duurkoop PW, Van HL, Dekker JJ. Dying too soon: excess mortality in severe mental illness. Frontiers in Psychiatry. 2019:855.

18. Chesney E, Goodwin GM, Fazel S. Risks of all-cause and suicide mortality in mental disorders: a meta-review. World Psychiatry. 2014 Jun;13(2):153-60.

19. Weye N, Momen NC, Christensen MK, Iburg KM, Dalsgaard S, Laursen TM, et al. Association of specific mental disorders with premature mortality in the Danish population using alternative measurement methods. JAMA Network Open. 2020 Jun 1;3(6):e206646.

20. Schaal K, Tafflet M, Nassif H, Thibault V, Pichard C, Alcotte M, et al. Psychological balance in high level athletes: gender-based differences and sport-specific patterns. PloS One. 2011 May 4;6(5):e19007.

21. Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The mental health of elite athletes: A narrative systematic review. Sports Medicine. 2016 Sep;46(9):1333-53.

22. Gulliver A, Griffiths KM, Mackinnon A, Batterham PJ, Stanimirovic R. The mental health of Australian elite athletes. Journal of Science and Medicine in Sport. 2015 May 1;18(3):255-261.

23. Duncombe SL, Tanaka H, De Larochelambert Q, Schipman J, Toussaint JF, Antero J. High hopes: lower risk of death due to mental disorders and self-harm in a century-long US Olympian cohort compared with the general population. British journal of sports medicine. 2021 Aug 1;55(16):900-5.

24. Silva-Moraes MH, Bispo-Torres AC, Barouh JL, Lucena PH, Armani-Franceschi G, Dorea-Bandeira I, et al. Suicidal behavior in individuals with amyotrophic lateral sclerosis: a systematic review. Journal of Affective Disorders. 2020 Dec 1;277:688-96.

25. Shepard MD, Perepezko K, Broen MP, Hinkle JT, Butala A, Mills KA, et al. Suicide in Parkinson's disease. Journal of Neurology, Neurosurgery & Psychiatry. 2019 Jul 1;90(7):822-829.

26. Erlangsen A, Stenager E, Conwell Y, Andersen PK, Hawton K, Benros ME, et al. Association between neurological disorders and death by suicide in Denmark. Jama. 2020 Feb 4;323(5):444-54.

27. Clarke PM, Walter SJ, Hayen A, Mallon WJ, Heijmans J, Studdert DM. Survival of the fittest: retrospective cohort study of the longevity of Olympic medallists in the modern era. Bmj. 2015 Jul;49(13):898-902.

28. Antero-Jacquemin J, Rey G, Marc A, Dor F, Haïda A, Marck A, et al. Mortality in female and male French Olympians: a 1948-2013 cohort study. The American Journal of Sports Medicine. 2015 Jun;43(6):1505-12.

29. Radonić V, Kozmar D, Počanić D, Jerkić H, Bohaček I, Letilović T. Mortality and causes of death among Croatian male Olympic medalists. Croatian Medical Journal. 2017 Aug 10;58(4):263-269.

30. Keller K. Life expectancy of Olympic wrestling champions in comparison to the general population. Journal of Community Health. 2019 Feb;44(1):61-67.

31. Takeuchi T, Kitamura Y, Sado J, Hattori S, Kanemura Y, Naito Y, et al. Mortality of Japanese Olympic athletes: 1952–2017 cohort study. BMJ Open Sport & Exercise Medicine. 2019 Nov 1;5(1):e000653.

32. Thieme L, Fröhlich M. Do former elite athletes live longer? New evidence from German olympic athletes and a first model description. Frontiers in Sports and Active Living. 2020 Nov 6;2:588204.

33. Gouttebarge V, Castaldelli-Maia JM, Gorczynski P, Hainline B, Hitchcock ME, Kerkhoffs GM, et al. Occurrence of mental health symptoms and disorders in current and former elite athletes: a systematic review and meta-analysis. British Journal of Sports Medicine. 2019 Jun 1;53(11):700-706.

34. Stern RA, Riley DO, Daneshvar DH, Nowinski CJ, Cantu RC, McKee AC. Long-term consequences of repetitive brain trauma: chronic traumatic encephalopathy. PM&R. 2011 Oct 1;3(10):S460-7.

35. Galgano MA, Cantu R, Chin LS. Chronic traumatic encephalopathy: the impact on athletes. Cureus. 2016 Mar 14;8(3):e532.