

Preventing racehorse injuries and fatalities- updates on what we know and where we are going

Ashleigh Morrice-West

Equine Centre, University of Melbourne, Ashleigh.morrice@unimelb.edu.au

Keywords: Thoroughbred racing, injury prevention, stride monitoring

1. Background

Serious injuries and fatalities in Thoroughbred racehorses affect not only the horses but also their riders, and the social licence of the racing industry as a whole. Globally, there has been an increasing drive to understand how and why these injuries are occurring with the aim to develop strategies that reduce all foreseeable incidents. There is now research consensus demonstrating that injuries in racehorses are not typically spontaneous, but instead develop over a period of time due to the cumulative loading with each stride, termed (for the skeletal system) bone fatigue.^{1,2} In racehorses, there are at least two major pathways to musculoskeletal injury (MSI) beyond the much less common scenario of a true traumatic incident. Firstly, bone fatigue injuries via microdamage accumulation following a period of intensive loading beyond the repair capacity; and secondly where bone fatigue injuries are caused by loading of unadapted or de-adapted bone, for example as seen early in a training period at comparatively low training intensities.¹

The most recent pooled global incidence of catastrophic musculoskeletal injury (CMI) in racing was 1.17 (95% CI 0.90, 1.44) per 1,000 flat race starts.² Whilst pooled rates in Australia and New Zealand were lower than the US (0.43 vs 1.62 per 1,000 starts, respectively; $p < 0.001$),² there has been no decline over the past 20+ years, with the most recent incidence of horse fatalities in Victoria (CMI and sudden death) 0.55 (95% CI 0.50, 0.61) per 1,000 starts.³

This presentation will review updates on risk factors for racehorse injury and fatality, sensor based research, other screening tools and future directions in injury prevention.

2. Risk factors for injury and fatality

Risk factors vary between racing jurisdictions, however there is consistent evidence that entire males, older horses, firmer track surfaces (for turf tracks), higher classed races and larger field sizes are associated with increased CMI risk.² At the local level, in Victoria, Australia, specific types of horses present higher risk, for example older international male horses as well as horses commencing their racing careers at older ages.³ Workload factors such as racing preparations over 10 weeks have been shown to be associated with increased injury risk in both Victoria³ and Queensland,⁴ consistent with greater accumulated bone fatigue over longer campaigns.⁵ But there have been conflicting findings reported between other studies, with more and less workload both increasing and decreasing risk.² This likely highlights the complexity of undergoing sufficient loading at an appropriate rate of introduction for an individual horse but that is not excess of their remodelling capacity.

3. Sensor based research for injury prevention

Stride characteristics for individual racehorses can now be recorded with wearable technology and this information used to quantify the impact of galloping on the skeleton over time. We have demonstrated that the largest variation in race-day stride characteristics is at the individual horse level, with horses maintaining a low intra-horse variation in stride parameters across race starts.⁶ It follows then, that deviations from a horse's typical stride pattern may suggest a subclinical or developing injury. We identified a more marked decline in speed and stride length for injured horses approximately six races prior to an MSI compared to an uninjured control population.⁷ For each 0.1 m/s decrease in speed, the risk of injury increased by 1.18 (95% CI 1.09, 1.28), and for each 10 cm decrease in stride length the risk of injury increased by 1.11 (95% CI 1.02, 1.21).⁷ Using feature importance in a machine learning approach, enforced rest (an outcome likely to largely reflect significant injury without a raceday diagnosis) was less likely to occur with greater increases in stride length two races prior, compared to an individual horse's baseline stride length.⁸ Yet machine learning approaches to prediction with the outcome of MSI performed poorly.⁸

4. Other screening tools and future directions

There is a clear need for continued targeted veterinary scrutiny of higher-risk sub-populations of horses. Biomarker monitoring has shown promise, at least in small numbers of horses, in being able to discriminate between uninjured horses and those sustaining a serious MSI.⁹ Three-dimensional imaging of fetlocks prior to racing for international competitors and elite horses racing in specific high-risk races provides some assurance that there are no (or minimal) underlying signs of pre-fracture pathology at the most common site of fracture.¹⁰⁻¹³ The introduction of PET scanning to Australia provides further scope to evaluate the level of activity and therefore potentially risk posed by certain pathologies in the distal limbs identified on CT/MR. Comparatively, horses starting racing at older ages are at higher risk of sustaining proximal limb fractures,¹⁴⁻¹⁶ likely due to the presence of unadapted bone. Full body scintigraphy is therefore a potential tool for detection of developing stress fractures in this subset of horses. Advanced imaging, however, is not practicable at the population level.

At the individual-horse level, there remains considerable difficulty in identifying specific horses at greater risk, with predictability of fracture in epidemiological models typically less than 70%. Real-time risk analyses for identifying horses at increased risk based on longitudinal workload monitoring would be ideal, but would require substantive improvements in data recording and management practices. Wearable technology does, however, provide opportunity for identification of individual horses at risk of adverse outcomes through serial data collection. At the population level this data could also inform future risk models and improve the current limited predictive capacity.

Despite these advances, preventive strategies like trainer education on the effects workload can have on injury risk and the importance of rest in facilitating bone repair following intense preparations should be a priority.

References

1. Martig S, Chen W, Lee PV, Whitton RC. Bone fatigue and its implications for injuries in racehorses. *Equine Vet J* 2014;46:408-415.

2. Hitchens P, Morrice-West AV, Stevenson M, Whitton RC. Meta-analysis of risk factors for racehorse catastrophic musculoskeletal injury in flat racing. *Vet J* 2018;245.
3. Morrice-West AV, Thomas M, Wong AS et al. Linkage of jockey falls and injuries with racehorse injuries and fatalities in Thoroughbred flat racing in Victoria, Australia. *Front Vet Sci* 2025;11:1481016.
4. Crawford KL, Finnane A, Phillips CJ et al. The risk factors for musculoskeletal injuries in thoroughbred racehorses in Queensland, Australia: How these vary for two-year-old and older horses and with type of injury. *Animals* 2021;11:270.
5. Whitton R, Ayodele B, Hitchens P, Mackie E. Subchondral bone microdamage accumulation in distal metacarpus of Thoroughbred racehorses. *Equine Vet J* 2018;50:766-773.
6. Morrice-West AV, Hitchens PL, Walmsley EA et al. Variation in GPS and accelerometer recorded velocity and stride parameters of galloping Thoroughbred horses. *Equine Vet J* 2021;53:1063-1074.
7. Wong A, Morrice-West A, Whitton R, Hitchens P. Changes in Thoroughbred speed and stride characteristics over successive race starts and their association with musculoskeletal injury. *Equine Veterinary Journal* 2022.
8. Bogossian PM, Nattala U, Wong AS et al. A machine learning approach to identify stride characteristics predictive of musculoskeletal injury, enforced rest and retirement in Thoroughbred racehorses. *Sci Rep* 2024;14:28967.
9. Ayodele BA, Pagel CN, Mackie EJ et al. Differences in bone turnover markers and injury risks between local and international horses: A Victorian Spring Racing Carnival study. *Equine Vet J* 2025;57:333-346.
10. Irandoust S, O'Neil LM, Stevenson CM et al. Comparison of radiography and computed tomography for identification of third metacarpal structural change and associated assessment of condylar stress fracture risk in Thoroughbred racehorses. *Equine Vet J* 2024.
11. Tranquille C, Parkin T, Murray R. Magnetic resonance imaging-detected adaptation and pathology in the distal condyles of the third metacarpus, associated with lateral condylar fracture in Thoroughbred racehorses. *Equine Vet J* 2012;44:699-706.
12. Peloso JG, Cohen ND, Vogler JB, Marquis PA, Hilt L. Association of catastrophic condylar fracture with bony changes of the third metacarpal bone identified by use of standing magnetic resonance imaging in forelimbs from cadavers of Thoroughbred racehorses in the United States. *Am J Vet Res* 2019;80:178-188.
13. Beck C, Hitchens PL, Whitton RC. Post-mortem computed tomography features associated with fracture of the fetlock joint in racing Thoroughbreds. *Equine Vet J* 2025.
14. Carrier TK, Estberg L, Stover SM et al. Association between long periods without high-speed workouts and risk of complete humeral or pelvic fracture in thoroughbred racehorses: 54 cases (1991-1994). *J Am Vet Med Assoc* 1998;212:1582-1587.
15. Vallance SA, Entwistle RC, Hitchens PL, Gardner IA, Stover SM. Case-control study of high-speed exercise history of Thoroughbred and Quarter Horse racehorses that died related to a complete scapular fracture. *Equine Vet J* 2013;45:284-292.
16. Whitton R, Walmsley E, Wong A et al. Associations between pre-injury racing history and tibial and humeral fractures in Australian Thoroughbred racehorses. *Vet J* 2019;247:44-49.