Institution: Liverpool John Moores University (LJMU)

Unit of Assessment: UOA24

Title of case study: Blood, Sweat and Tears: The development of bespoke nutrition support to improve the physical and mental health of jockeys

Period when the underpinning research was undertaken: 2010-2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Graeme Close	Professor	2010 – present
James Morton	Professor	2010 – present
George Wilson	Researcher	2010 – present
Daniel Martin	Researcher	2015 – present

Period when the claimed impact occurred: 2012 - 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Known as the "Sport of Kings" generating £3.4 billion *per annum* to the UK economy and supporting almost 100,000 UK jobs, professional horse-racing has been part of British culture since the 12th Century. Despite this noble history, jockeys are often treated as a commodity with the majority of support focused upon the horse. Jockeys are required to achieve extremely low body weights, often through unhealthy and dangerous techniques including starvation, dehydration and forced vomiting. Our research has documented the dangers of this approach and produced alternate weight-making methods which have been adopted internationally. This has transformed jockey behavior and horse racing culture improving the welfare of jockeys and reducing the occupational risks of horse-riding. These changes also influenced the whole horse-racing industry through education, new policies, practices and resources which have been endorsed and adopted worldwide.

2. Underpinning research

Horse racing is estimated to contribute £3.4 billion to the UK economy. The industry employs 450 licensed jockeys in Great Britain who can race-ride for up to 362 days in the calendar year due to the use of all-weather tracks. Horse racing is reliant upon a healthy population of jockeys, who are unique athletes in that they are required to make-weight on a daily basis, often several times per day when they race. In the UK, the minimum riding weight for flat jockeys is 50.8 kg. This daily target requires daily weight-making practices, often including resorting to unhealthy behaviours such as starvation, forced vomiting, laxatives or extreme dehydration which has been shown to have major short and long term physical and mental health consequences. Collectively, our research has documented the extent of these problems and gone on to devise, test, and apply alternate methods to make weight safely. Over the past decade this research has resulted in almost £1 million in external research income and a vast body of literature however 6 original papers have been selected to structure this specific impact case study.

Our research has resulted in regulatory changes to increase minimum riding weights

Although the sport of horse racing was aware of the general issues associated with light riding weights, it was somewhat hesitant to change given its heritage. Our research was influential in providing the evidence base that justified rule changes to increase the minimum riding weights and ultimately improve the safety of jockeys. To assess the effects of a career of weight-making on physical and mental health, we recruited 37 professional jockeys. In collaboration with Prof Bill Fraser, a world leader in bone metabolism, we were able to demonstrate for the first time that the inappropriate weight-making techniques were having detrimental effects on biochemical markers of bone health increasing the risk of fractures. Moreover, using a multi-disciplinary approach, we also demonstrated that the archaic diets and constant sweating were having adverse effects on mood profiles, placing the jockeys at risk of mental health problems (REF 1). We also investigated if the techniques to make weight where not only dangerous to health but also adversely affected their race-riding ability, evidence that would be crucial in changing the mindset of jockeys, the horse owners and the horse trainers. We observed that acute dehydration (2% reduction in body weight) impaired riding performance and reduced muscle strength. This was the first time jockey performance had been tested using an ecologically-valid protocol of simulated race-riding using

professional jockeys. We concluded that even a small amount of dehydration to make weight could increase the risk of falls through reduced muscle strength as well as affecting the jockeys' ability to ride maximally reducing their earning potential (REF 2). Our novel qualitative research, the first to document jockeys own thoughts and perceptions on riding weights and continuous weight-making, identified that jockeys resent the need to use harmful practices when required to achieve the lightest weights and that increased minimum weights may mitigate the need to do so (REF 6).

Our research has informed improved dietary practices of jockeys

Professional jockeys for the first time now have a thorough, research informed understanding of the energetic demands of their sport and their life as a working jockey. This information has led to an improvement in their dietary practices and greater success with weight management. A key barrier was that the industry held perceptions that professional horse riding was a high energy-demand sport, and therefore jockeys were being advised to consume a high carbohydrate diet, typical of other athletes. It was therefore crucial to measure the energy expenditure of jockeys during a standard working day something that up to then had proven impossible to achieve. At the time, racing rules did not allow monitors to be worn during real race-riding, therefore we created a laboratory-based simulation protocol. Utilizing this simulation, along with jockeys wearing portable trackers throughout their working day, we demonstrated for the first time that the energy cost of race-riding was low (approximately 40 Kcal per race) resulting in a mean daily energy expenditure of only 2,690 Kcal (REF 3). We therefore concluded that the current dietary advice and instructions given to jockeys were incorrect and new nutrition guidance needed to be urgently developed. We have since confirmed and extended these data and, for the first time in jockeys, we used the gold standard technique of doubly labelled water to assess energy expenditure in jockeys during their daily activities. This study reported a mean energy expenditure of only 2,587 Kcal (REF 4) confirming our hypothesis that jockeys do not have a high energy expenditure and thus the standard nutrition advice needed to change.

Using the energy expenditure data from REF 3 and REF 4, we systematically and empirically tested the hypothesis that elite jockeys could make weight safely whilst following a healthy diet, eliminating the need for acute dehydration and other health-risk weight loss strategies (REF 5). In research funded by HH Sheikh Mansour Bin Zayed Al Nahyan Global Arabian Horse Flat Racing Festival, we recruited and fed professional jockeys an alternate diet for 6-weeks and provided them with bespoke exercise advice. Every meal for a 6-week period was provided by ourselves to professional jockeys with each meal individually designed to their specific needs. We monitored changes in body composition alongside their physical and mental health. The most important and novel outcomes were that the jockeys could safely make-weight safely if they adopted a change to their nutritional practices which would allow them to eat on a regular basis, consume appropriate micronutrient intakes and avoid the need for rapid dehydration and forced sweating.

Our research has been instrumental in changing the education provided at jockey licensing, their early career education, and updating the current racecourse catering provision

Changes to catering regulations for the 59 British racecourses, and jockey licensing and early-career education were underpinned by LJMU research. Despite our research demonstrating the benefits of the LJMU approach to weight-making in jockeys (REF 5), there was still some resistance in the racing industry to adopt such guidance. Using the unique connections established between LJMU, the British Horseracing Authority (BHA), and the wider industry, we embarked upon qualitative research (REF 6). We explored the perceptions of not only the jockeys, but key stakeholders such as horse owners, trainers and jockeys agents, groups within the industry who are notoriously elusive to research and to interview. Our reputation in jockey research in combination with our industry-involved research team facilitated the uncommon access to these stakeholders, aiding us to identify the specific barriers to behaviour change. This research indicated a lack of nutrition education and opportunity within the industry for jockeys to engage in and practice optimal nutrition behaviours. REF 6 provided the blueprint necessary to implement a comprehensive behaviour change and education package specific to the needs of jockeys, much of the content directly relating to REF 1-5 and other LJMU jockey research not shortlisted here.

3. References to the research

All of the references are published in high quality international peer reviewed journals following a rigorous internal and external peer review process.

REF1: Wilson G, Fraser WD, Sharma A, Eubank M, Drust B, Morton JP, Close GL (2014). Markers of bone health, renal function, liver function, anthropometry and perception of mood: a comparison between Flat and National Hunt Jockeys. Int J Sports Med. 34,453-9. doi: 10.1055/s-0032-1321898.

REF 2: Wilson G, Hawken MB, Poole I, Sparks A, Bennett S, Drust B, Morton J, Close GL (2014). Rapid weight-loss impairs simulated riding performance and strength in jockeys: implications for making-weight. J Sports Sci. 32, 383-91. doi: 10.1080/02640414.2013.825732.

REF3: Wilson G, Sparks SA, Drust B, Morton JP, Close GL (2013). Assessment of energy expenditure in elite jockeys during simulated race riding and a working day: implications for making weight. Appl Physiol Nutr Metab. 38,415-20. doi: 10.1139/apnm-2012-0269.

REF4: Wilson G, Lucas D, Hambly C, Speakman JR, Morton JP, Close GL (2018). Energy expenditure in professional flat jockeys using doubly labelled water during the racing season: Implications for body weight management. Eur J Sport Sci. 18,235-242. doi: 10.1080/17461391.2017.1406996.

REF5: Wilson G, Pritchard PP, Papageorgiou C, Phillips S, Kumar P, Langan-Evans C, Routledge H, Owens DJ, Morton JP, Close GL (2015). Fasted Exercise and Increased Dietary Protein Reduces Body Fat and Improves Strength in Jockeys. Int J Sports Med. 36,1008-14. doi: 10.1055/s-0035-1549920.

REF6: Martin, D., Wilson, G., Morton, J. P., Close, G. L., & Murphy, R. C. (2017). The horseracing industry's perception of nutritional and weight-making practices of professional jockeys. Qualitative Research in Sport, Exercise and Health, 9(5), 568-582. doi: 10.1080/2159676X.2017.1340330

Grants awarded to fund the research

2013-2015: Sheikh Mansoor Bin Zayed Al Nahyan Global Arabian Horse Flat Racing Festival (£180,000). Nutritional strategies to improve the physical and psychological health of jockeys (Professor Graeme Close - Lead Applicant to employ Dr George Wilson as a Post-Doctoral researcher)

2015-2018: British Horse Racing Authority (£22,500). Development and evaluation of a nutritional education package for elite jockeys (Graeme Close - Lead Applicant to employ Dan Martin PhD).

2016-2019: Racing Welfare UK (£207,902). Nutritional intervention to improve jockey and stable staff welfare and change current weight-making culture (Graeme Close - Lead Applicant to employ Dr George Wilson as a Post-Doctoral researcher).

2018-2020 The Racing Foundation (£96,000). Racing Industry Mental Health Research (Dr Martin Littlewood – Lead Applicant to employ Dr Will McConn as a Post-Doctoral researcher)

2019-2021 The Racing Foundation (£185,000). An Education and Support Intervention for Racehorse Trainers to Improve Jockey and Stable Staff Welfare and Embed Athletic Lifestyle and Culture (Dr Rebecca Murphy – Lead Applicant to employ Dr Dan Martin as a Post-Doctoral researcher)

2020-2023 The Racing Foundation (£76,390). Defining the Jockey Athlete (Prof Graeme Close -Lead Applicant to employ Emma Hamilton as a PhD student with a specific focus to investigate female jockeys).

2016-2019: Racing Welfare UK (£165,000). Continuation Grant. Nutritional intervention to improve jockey and stable staff welfare and change current weight-making culture (Graeme Close - Lead Applicant to employ Dr George Wilson as a Post-Doctoral researcher).

Total External Income £910,292

4. Details of the impact

Our research has documented the dangers of current weight-making practices in professional jockeys, investigated safer strategies to make weight, and then used this to change dietary plans. These dietary plans have been implemented (and evaluated), and have proven to be successful in helping jockeys to make weight, changing their risky and unhealthy weight making practices and improving their physical and mental health. As well as direct changes to jockey behaviours and health, this work has contributed to a change in the rules of the sport. Furthermore, our nutritional guidelines now feature in every racetrack in Great Britain. As part of a significant communication strategy around this work, the team have been invited around the world to share our expertise with other international racing authorities (see below for list of countries). The work has featured on numerous mainstream media TV channels including Channel 4 Racing (UK), ITV Racing (UK), Racing UK (UK), At The Races (UK), and Dubai Racing TV (UAE), as well as Radio such as BBC Radio 5 Live (UK), Talk Sport (UK) and ESPN (USA).
The main impacts of this research are described below and relate to rule changes, nutritional support programmes, industry cultural changes and educational models in horseracing.

1. Minimum Riding Weight Rule Change

Our research has resulted in a unique rule change by horse racing authorities in GB which has reduced the severity of weight-making. Racing weights for jockeys in GB were amongst the lightest worldwide, despite having statistically the tallest and heaviest jockeys compared to those from other leading racing nations. **REF 1 and 2** determined the physical, physiological and mental health risks of jockeys "making-weight". With the industry already aware of the potential problems caused by continuous acute weight loss and prolonged periods of energy restriction, **REF 1** and **REF 2** were the first studies to document and prove the problem. This detailed information was a catalyst in the increase in GB minimum riding weights from 49.3 kg to 50.8 kg as confirmed by the BHA Chief Medical Officer Dr Jerry Hill (**Evidence 1**). This rule change led to a reduction in emphasis on the rapid and excessive weight loss techniques that have detrimental health and performance effects**.** Sir AP McCoy (the most successful jump-jockey of all time) reported in a BBC interview about our research, that falling when dehydrated is when you "do the most damage" (**Evidence 2**) highlighting the impact and importance of this rule change that was based upon our research**.**

2. Jockey-specific Lab-based Testing & Sports Science Support

Our research has resulted in the development and implementation of a jockey-specific diet and lifestyle intervention programme which has improved the physical and mental health of jockeys. Collectively, the research (**REF 3,4 and 5**) has directly changed and improved the diets of jockeys through improved understandings of the nutritional requirements of jockeys along with a proven strategy as how to make-weight safely without resorting to starvation techniques. All jockeys are now invited to LJMU for nutrition testing and education with diets prescribed based upon on our research. By providing evidence and showing jockeys how this can be successfully applied to them, the new dietary plans have had a dramatic effect on their weight-management practices as well as physical health, and psychological wellbeing. We also developed a battery of assessments based upon our jockey-based research which has now resulted in an intervention support program exclusively for jockeys and endorsed by the industry bodies. The service is promoted by the BHA and PJA and features on a series of short education documentaries for jockeys **(Evidence 7) and promoted during jockey licensing (Evidence 6)**. To date, over 500 jockeys from around the world have visited LJMU for dietary and physical assessments and advice with our guidance documents now available in most major horse-racing nations. Indeed, in an interview for the BBC, the wife of jockey Paul Mulrennan said "I thought his lifestyle would kill him" but this all changed when he followed the research advice from LJMU (**Evidence 2**). The effectiveness of this research, and the change to jockey health has also been endorsed by Dr Jerry Hill (**Evidence 1**) whilst on Channel 4 horseracing Frankie Dettori MBE discussed how in 24 years of being a professional jockey he had never had sport science support to help him make weight safely (**Evidence 3**).

3. Development of Novel Racecourse Catering Regulations

Our research has resulted in cultural changes around the horseracing world such that new catering guidelines have been produced and changes to the minimum racecourse standards for food provision have occurred as a direct consequence of our work. The competition calendar in racing spans 362-days of the year, meaning jockeys are required to make weight and attend racecourses daily. Existing food provision was poor and deemed non-conducive to health, weight-management, or riding performance (**REF 6**). Our research directly influenced the development and implementation of Racecourse Catering Minimum Standards (**Evidence 4**). This development was endorsed by the BHA and made both mandatory and legislative. These new catering regulations cited the research from LJMU (**REF 3 and 5**). As a result, all 60 racecourses in GB, for the 1508 race meetings, are now required to provide catering provision based upon **REF 5** that suits the needs of jockeys. This improved food provision has reduced the perpetuation of rapid weight loss through dehydration, starvation, laxative use or self-induced vomiting (**Evidence 1, 2 and 3**). Moreover, every racecourse now displays nutrition education posters to translate our suggested new diet and exercise regime (**REF 5**) into language accessible by jockeys (**REF 6**) with LJMU clearly credited on these posters (**Evidence 5**).

4. Updated the Jockey Licensing Education

Our research has directly changed the model and content of jockey education provided within the British Racing School and Northern Racing College. During the two-week licensing courses for apprentice (flat) and conditional (jump) jockeys, the nutrition module now incorporates the evidence-based guidelines produced by LJMU (**REF 1-5**) including how best to translate this research (**REF 6**). The new curriculum is available in **Evidence 6** and has been received by approximately sixty new professional jockeys to date. In addition, the Jockey Education and Training Scheme (JETS), a charity that provides support and education to jockeys, have produced a series of "Jockey Matters" education films based on our research which are shown in racecourses across the world (**Evidence 7**). The Professional Jockeys Association now has their own nutrition support service using methods developed by LJMU (**Evidence 8**) whilst the Injured Jockeys Fund have incorporated the research from LJMU into the rehabilitation of injured jockeys (**Evidence 9**) via nutrition behavioural profiling and dietary guidance as part of their return-to-ride protocol. To date this has been used on approximately 60 jockeys. Based on our work the BHA and PJA have launched their #jockeyathlete diet campaign (**Evidence 10**) which Dr Jerry Hill (Chief Medical Adviser) described as a key visible outcome of the LJMU team's nutrition research. Paul Struthers, the Chief Executive of the Professional Jockeys Association when launching this campaign stated that "a lot of progress has been made [with regards to jockeys' diet and health] thanks to the support from LJMU (**Evidence 10**).

5. Sources to corroborate the impact

Evidence 1: Dr Jerry Hill MD (Chief Medical Adviser, BHA) letter of endorsement of impact of research on jockey health and weight-management, and development of new guidelines and regulation within the sport
Evidence 2: BBC News & BBC Inside Out documentary
Evidence 3: Channel 4 feature on the LJMU research
Evidence 4: New Racecourse Catering Guidelines and evidence of BHA rule change (from Apr 2019).
Evidence 5: Jockey racecourse posters
Evidence 6: NHC and PJA curriculum
Evidence 7: JETS Jockey Matters videos
Evidence 8: PJA Nutrition Guidelines
Evidence 9: IJF Nutrition guidelines
Evidence 10: British Horse Racing Authority Press Release on website