Institution: University of Chichester

Unit of Assessment: 24: Sport and Exercise Sciences, Leisure and Tourism

Title of case study: Preventing and Mitigating Injury in Sport, Leisure, and the Workplace through Evidence-Based Interventions

Period when the underpinning research was undertaken: September 2005-present

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:
1. Prof Stephen Myers	1. Professor of Exercise Physiology	1. 2005-to-date
2. Dr Trevor Dobbins	2. Research Fellow	2. 2005-to-2010
3. Dr Sam Blacker	3. Reader in Exercise Physiology & Nutrition	3. 2013-to-date
4. Dr Andy Siddall	4. Research Fellow	4. 2017-to-date
6. Dr Jason Lake	5. Reader in Sports Biomechanics	5. 2009-to-date
7. Neil Light	6. Senior Lecturer in Sport Therapy	6. 2012-to-date
8. Dr Neal Smith	7. Senior Lecturer in Sports Biomechanics	7.1996-to-date

Period when the claimed impact occurred: 2005-present

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

1. Summary of the impact (indicative maximum 100 words)

Injury and impaired physical performance are key concerns in sport, leisure and workplace settings, resulting in significant personal and financial costs to individuals and organisations. Research conducted by 8 University of Chichester (UoC) academics has informed the development of evidence-based strategies to mitigate injury risk and optimise physical performance in elite sport, physically demanding occupations (e.g., the UK Armed Forces, NATO, RLNI) and marine leisure activities.

The impact of this research spans 3 domains:

1. Changing professional practice and guidance of government agencies, organisations and employers across the globe
2. Influencing equipment procurement decisions and providing commercial advantage for businesses
3. Supporting technical and process innovations in commercial organisations

2. Underpinning research

Over the past 20 years, UoC researchers have conducted wide-ranging applied and fundamental research to inform evidence-based strategies to reduce the incidence and severity of injuries, inform decisions regarding treatment and return to duties/play, and maintain or enhance physical performance in a range of sports, maritime leisure activities and physically demanding occupations. This research has collectively received c. GBP1,480,000 (c. GBP1,300,000 retained) of competitively tendered external funding and has formed the basis of over 40 peer-reviewed articles in high standing journals. It spans 4 overlapping areas:

Quantifying physical risks of High-Speed Marine Craft (HSMC) transits

UoC researchers (Myers, Dobbins) completed an ESPRC-funded project (**F1**: GBP341,758) between 2005 and 2008. First, this research quantified the negative effects of long duration HSMC transits on the physical performance of UK Armed Forces personnel [**R1**]. Second, further studies demonstrated that using suspension seats in HSMC ameliorated these

negative effects, reducing injury risk and maximising physical performance [**R2**]. In 2020, Myers and Dobbins conducted a RNLI commissioned review which identified similar issues in their D-Class lifeboats and identified physical training interventions to reduce injuries [**F9**].

Predicting injury attrition and performance in military training

UoC researchers led 6 MoD-funded projects [**F2-7**] between 2015 and 2020 to develop ways of using wearable-technology to inform injury mitigation and physical training strategies. This research developed techniques to measure daily physical activity, sleep, energy balance and injury incidence. 2 exemplar projects were: (1) monitoring British Army Officer Cadets throughout their 44-week Commissioning Course [**R3**], the first research to follow cohorts of recruits through their training programme, and (2) monitoring candidates undertaking the All-Arms Pre-Parachute Selection Course. Importantly, these studies demonstrated the practicality and validity of using a research-grade accelerometer-based activity monitor (GeneActiv, Activinsights, UK), in a highly active population, for a prolonged period in military occupational settings. These studies led to a further collaborative study between UoC and Canadian Armed Forces (CAF) researchers to utilise these methods with CAF personnel, which then informed a wider CAF research programme to optimise physical performance and mitigate injury risk.

Evaluating injury screening procedures in youth football

UoC researchers (Light and Smith) initiated a programme of research examining hip and groin screening in elite youth football in 2015. Hip and groin injuries are responsible for between 7-12% of all injuries in youth football and, given this prevalence, injury screening and reduction strategies are essential. The UoC-led research identified that many different screening practices were used by medical practitioners in professional football academies [**R4**]. To enhance and standardise medical practice, this programme of research identified the long-lever in adduction test to be the most reliable, valid, and responsive examination tool for effective risk identification [**R5**].

Challenging force-plate data collection and processing methods

Since 2009, Lake's programme of research has challenged and directly influenced the way force-time data are recorded, processed, and applied in strength and conditioning (S&C) research and professional practice (injury prevention and rehabilitation). The research has validated standardised collection protocols [**R6**] and developed innovative new metrics to facilitate assessment of the effects of training, competition, and injury on athlete capacity (or readiness to play/return to play), helping to maximise the efficient and effective practical application of force-time data in S&C settings, and informing the development of the first commercial wireless force plate system.

3. References to the research (indicative maximum of six references)

Peer-reviewed journal articles

R1. Myers, S. Dobbins, T. King, S. Hall, B. Ayling, R. Holmes S.R., Gunston, T. & Dyson, R. (2011) Physiological consequences of military high-speed boat transits. *European Journal of Applied Physiology*, 11(9), 2041-2049. doi: 10.1007/s00421-010-1765-3

R2. Myers, S. Dobbins, T. King, S. Hall, B. Holmes, S.R. Gunston, T. & Dyson, R. (2012). Effectiveness of suspension seats in maintaining performance following military high-speed boat transits. *Human Factors*, 54(2), 264-276. doi: 10.1177/0018720811436201

R3. Siddall, A.G., Powell, S.D., Needham-Beck, S.C., Edwards, V.C., Thompson, J.E. S., Kefyalew, S.S., Singh, P.A., Orford, E.R., Venables, M.C., Jackson, S., Greeves, J.P., Blacker, S.D. & Myers, S.D. (2019). Validity of energy expenditure estimation methods during 10 days of military training. *Scandinavian Journal of Medicine & Science in Sports*, 29, 1313-1321. doi.org/10.1111/sms.13488

R4. Light, N., Smith, N.A., Delahunt, E. and Thorborg, K. (2018) Hip and groin injury management in English youth football: A survey of 64 professional academies. *Science and Medicine in Football*, 2(2), 133-140. doi.org/10.1080/24733938.2018.1441536

R5. Light, N. and Thorborg, K. (2016) The precision and torque production of common hip adductor squeeze tests used in elite football. *Journal of Science and Medicine in Sport*, 1(11), 888-892. doi.org/10.1016/j.jsams.2015.12.009
R6. Lake, J., Mundy, P., Comfort, P., McMahon, J.J., Suchomel, T.J., and Carden, P. (2018). Concurrent validity of a portable force plate using vertical jump force-time characteristics. *Journal of Applied Biomechanics*, 34(5), 410-413. doi.org/10.1123/jab.2017-0371

The above research was published in a range of international peer-reviewed scientific journals. ***All outputs are available on request.***

Research Funding (This research has been supported by the following research contracts – total value c. GBP1,480,000)
F1. Engineering and Physical Sciences Research Council EP/C525744/1 – Design of High-Performance Marine Craft from a Human Factors Perspective – GBP341,578
F2. Defence Human Capability Science & Technology Centre (DHCSTC) 3.200 - Measurement of Leisure and Occupational Physical Activity Exposure – Phase 1 – GBP180,000
F3. DHCSTC 3.200 - Measurement of Leisure and Occupational Physical Activity Exposure - Phase 2 – GBP512,000
F4. Defence and Security Accelerator ACC6005470 – A Physical Activity Capture & Evaluation System (PACES) to Inform Musculoskeletal Injury (MSKI) Prevention Strategies in Service Personnel – GBP100,000
F5. Analysis Support Construct (ASC) Task-0165 – The Development of Physical Employment Standards for non-Ground Close Combat (non-GCC) roles in the British Army: Physically Demanding Courses Linked to Selection and Promotion – Pre-Parachute Selection – GBP118,000
F6. ASC Task 0257 – Novel Strategies to Improve Exercise Training Prescription – GBP52,000
F8. HSSRC 1.027 – Data Analytics to Maximise Human Performance GBP167,000
F9. Royal National Lifeboat Institution ON0271330-1 – Review of Whole-body Vibration in relation to Royal National Lifeboat Institution (RNLI) Inshore Lifeboat Operations – GBP10,000

4. Details of the impact (indicative maximum 750 words)

Changing professional practice and guidance of government agencies, organisations and employers across the globe

Our research into the effects of seating in HSMC led to the publication, by Dobbins, of the High-Speed Craft Human Factors Engineering Design Guide in 2008. This raised awareness of the consequences of seating design in HSMC and stimulated policy and regulatory debates. In 2011 the guide led directly to the inclusion of seating guidance for HSMC in Marine Guidance Note 436 (M+F), a publication designed to inform industry standards and enhance maritime safety [**C1**]. Since 2013, the guide and MGN436 (M+F) have informed 4 other Maritime & Coastguard Agency codes (*The Workboat Code (2nd Edn)*, 2018 [**C2**]; *The Police Boat Code – Common Code*, 2013; *The Hovercraft Code*, 2014; and *The Rescue Boat Code*, 2014). All relevant UK vessels and international vessels operating in UK waters are legally required to comply with these codes to gain certification.

The guide also informed *The High-Speed Passenger Vessel Code* (2019) produced by the Royal Yachting Association, British Marine, and the Passenger Boat Association. In 2017, the number of just a single class of boats impacted by this code – Rigid Inflatable Boats (RIBS) – amounted to 41,000 craft in the UK alone. Tom Gunston, Chair of the British Standards Technical Committee on Human Response to Vibration and Mechanical Shock, confirms that our work was 'transformative for the fast boat seating sector' [**C3**]. This insight is further supported by references to MGN436 (M+F) in marine accident investigation reports (e.g., **C4** (2010 and 2016)), which echo UoC findings on seating design on marine safety.

More broadly, our HSMC research has also stimulated policy debate within NATO who, in 2019, justified the needed for a NATO task group to further explore seating-related injury risks on HSMC [**C5**].

Our research has informed a variety of armed forces training and selection practices. For instance, our research has been used to inform injury risk management during British Army Officer Cadet training at the Royal Military Academy Sandhurst (RMAS), affecting c. 600 UK and overseas recruits per annum. The research has also provided underlying methodologies used in the programme of research dedicated to understanding the impact of arduous training on females in ground-close combat roles. According to Professor Julie Greeves OBE, Principal Physiologist and Assistant Head of the Army Health Branch, this 'research undertaken by the UoC has had significant impact in Defence by informing approaches to training at RMAS and other basic training Units […] and shaping wider initiatives on wearable technology', within 'the most comprehensive research that the UK Army has undertaken on its personnel in a Basic Training environment'. Our research has also had international reach, with methods that UoC researchers have developed used in collaborative research with the Canadian Armed Forces (CAF) and now applied as injury risk screening tools in CAF Officer Cadet and Infantry training [**C6**].

Our research in sport has challenged conventional knowledge and practices. Lake's fundamental research challenging and shaping the use of force-plate data has been widely adopted by S&C research units in North America, Australia and Europe, increasing confidence in the accuracy of research findings [**C7**]. In turn, via extensive dissemination efforts (including podcasts reaching audiences of over 6,000 S&C coaches), this research has also informed day-to-day monitoring and assessment practices in a range of sporting organisations across the world, increasing confidence in key training and competitions decisions [**C8**]. The Sport Science Coordinator of the Miami Dolphins states that Lake's research and dissemination activities enhanced decision-making processes concerning the readiness of their athletes to return to competition following injury. Light has impacted on the day-to-day practices of international elite sports organisations. 4 professional football academies in the UK and overseas have adopted the long-lever test based on UoC research and dissemination activity [**C9**].

Informing procurement decisions and providing commercial advantage to businesses
The revisions to practice guidance and policy driven by our research findings have changed procurement decisions in a range of organisations, helping to enhance the commercial success of supplier companies. UoC research showing the importance of suspension seating on HSMC lead to the development of UK MoD and US Navy test performance codes, which inform current HSMC seat design and procurement patterns in military and search and rescue fleets [**C3**, **C10**, **C11**]. In 2015, for example, the UK MoD purchased 60 vessels (420 seats @ c. GBP1,200 per unit). In a similar way, our research examining the efficacy of physical activity monitors has increased the procurement of Activinsights's (a UK-Based SME specialising in digital health products; turnover c. GBP570,000) GENEActiv monitors [**C12**]. Furthermore, the work that we have completed with CERVUS (a UK-based, veteran-owned SME specialising in data analytics and visualisation; turnover c. GBP2,000,000) has informed their design of various software systems and contributed to successful contract tendering amounting to c. GBP1,200,000 [**C13**].

In sport, Lake's research stimulated the 2017 start-up Hawkin Dynamics, a force plate manufacturing company, and has informed their product design and support services ever since. Lake's research, dissemination activity and consultancy with this company has contributed to revenue growth and enhanced customer satisfaction [**C14**]. Currently, the company employs 10 people and has an annual revenue of c. USD1,270,000.

Supporting technical and process innovations in commercial organisations
Through various research collaborations, consultancies and dissemination activities, UoC research has helped enhance the performance of existing businesses through the

development of products, processes, and services. Our HSMC research was the catalyst for a successful start-up Human Factors company, STResearch Ltd, which incorporated our findings into its consultancy work [**C11**]. In military contexts, our collaborations with CERVUS have upskilled staff members and led to refinements in their commercial software packages [**C13**]. Activinsights also report that our research has informed enhancements to their product configurations and specifications [**C12**]. Lake's work with Hawkin Dynamics has informed the development of their software, guidance and support for customers, contributing to their growth as a company [**C14**].

5. Sources to corroborate the impact (indicative maximum of 10 references)

C1. Marine Guidance Note (MGN) 436 (M+F): WHOLE-BODY VIBRATION: Guidance on Mitigating Against the Effects of Shocks and Impacts on Small Vessels.
C2. Example of regulatory guidance informed by research: Maritime and Coastguard Agency's *The Workboat Code (2nd Edn)* (2018).
C3. Testimonial statement from Tom Gunston confirming industry-wide impact of HSMC research.
C4. Examples of marine accident investigation reports citing HSMC research:

i. MAIB report on the investigation of an injury to a passenger on board a Delta 8.5m RIB on the River Thames, London, on 6 May 2010.
ii. MAIB report on the collision between Osprey and Osprey 2 resulting in serious injuries to one passenger, Firth of Forth, Scotland (19 July 2016).

C5. Testimonial letter from Yohann Robinson, Chief Medical Officer of the Swedish Armed Forces, confirming the formation of NATO research group and the invitation to Steve Myers to chair the group.
C6. Testimonial statements confirming impact of research activities on physical activity monitoring practices and research in UK and Canadian Armed Forces:

i. Professor Julie Greeves OBE PhD, Principal Physiologist and Assistant Head, Army Health Branch.
ii. Dr Tara Reilly, Senior Research Officer, Human Performance Research & Development, Canadian Armed Forces.

C7. Signed declaration from15 internationally leading researchers supporting the impact of Lake's force plate research on research activity.
C8. Sporting organisation testimonials confirming the impact of research activities on injury screening activities, return to play protocols and procurement decisions:

i. Emily Cain, Physical Performance Coach with English Football Association.
ii. Dr Paul Caldeck, Former S&C coach with West Bromwich Albion FC.
iii. Adam Lachance, Sport Science Coordinator with Miami Dolphins.
iv. David Meechan, S&C coach with Hong Kong Sport Institute.
v. Eric Reneghan, Former Head of Sport Science with St Louis Blues, NHL.
vi. Jack Wells, Education Officer, English Golf Union.

C9. Sporting organisation testimonials confirming the impact of research activities on use of long-lever adduction test:

i. Scot McAllister, Head of Physiotherapy (Academy), Manchester City Football Club.
ii. Adam Johnson, First Team Performance Physiotherapist, Brighton & Hove Albion Football Club.
iii. Matt de Lang, Residency-trained Sports Physical Therapist, FC Dallas.
iv. Andrew Proctor, Lead First Team Physiotherapist, Bristol City Football Club.
v. Martin Woolin, La Trobe University, Australia.

C10. Testimonial statement from Carl Magnus Ullman, CEO of Ullman Dynamics.
C11. Testimonial statement from Dr Trevor Dobbins, Director, STResearch Ltd.
C12. Testimonial statement from Joss Langford, Chief Technology Officer, Activinsights
C13. Testimonial statement from Paddy Little, Technical Director of Cervus Defense and Security Ltd.
C14. Testimonial statement from Bennet Watson, CEO of Hawkin Dynamics.