

Institution: University of Brighton
Unit of Assessment: C26 Sport and Exercise Sciences, Leisure and Tourism
Title of case study: Improving athletes' preparation for optimal sporting performance ICS [2]
1. Summary of the impact

The impact of this research has been to improve the performance of elite athletes and safeguard the well-being of Paralympians. It has affected the management of athletes' dynamic physiological responses and advanced the regulatory frameworks of sporting bodies. This has changed the strategies of the USA Olympic Committee, the International Paralympic Committee and the British Paralympic Association. The indirect impact of this primary research has been to change the routine training practices of recreational athletes and influence the advice on exercise given to military personnel and people with disabilities.

2. Underpinning research

Origins: Sport and exercise science research at the University of Brighton (UoB) has its origins in the 1980s. Dedicated laboratories were established and equipped to measure human function in exercise and in many sports, from rest to maximum effort, and UoB had one of the first laboratories to have a dedicated environmental chamber. Environmental investigations utilise the specially constructed chambers to control heat, cold, humidity and oxygen partial pressure and focus on the application of fundamental environmental physiology to the exercising human athlete. The research has been characterised by rigorous analysis of the methodologies and their application to the assessment and enhancement of sports and exercise performance across different activities and environmental conditions, for people of all abilities and those with disabilities [references 3.1, 3.2, 3.3, 3.4].

Early work by Jones and DOUST [3.1] was the first publication to validate a laboratory-based test to 'normal' exercise performance outside of laboratories. They showed that starting a treadmill test with a 1% gradient effectively mimics the average outdoors conditions experienced during running. People using treadmills with a 1% incline would, therefore, be tested and assessed for their performance in conditions similar to those exercising outdoors. This research informed the methods and hypotheses of subsequent laboratory-based research at UoB [3.3], which showed how scientific evidence can be used to improve the prediction of the consequences of training and preparation in particular locations and conditions for sport (eg, events in warm regions) and so enhance strategies to improve the performance of athletes.

Broadening the field: Research at UoB has encompassed continuous types of exercise and, more recently, intermittent sprint type exercise, simulating the changes in pace experienced in field sports such as football, rugby and hockey. Using rigorous science in sports-relevant protocols, including intermittent and repeated sprint exercise, MAXWELL, Castle, WEBBORN and WATT have demonstrated how improved performance in hot conditions can be achieved by optimal precooling strategies, leading to significant gains in work done in such conditions [3.3].

Related UoB research in Paralympic medicine started in the late 1990s. This has extended the initial research further by developing new understandings of the thermoregulatory physiology of novel situations, such as those exhibited by tetraplegic athletes, who do not have normal physiological control mechanisms for sweating and body temperature regulation. The research has identified the appropriate interventions and the best forms of support that are required to enable Paralympic athletes to compete more safely in all environments and to perform to the best of their ability safely [3.4].

Further Paralympic research involved large-scale multinational studies monitoring injury occurrence at the Summer and Winter Paralympics [3.2, 3.5]. The research has revealed the complex medical and physiological interactions that occur in Paralympic athletes, defining the patterns and incidence of injury and illness [3.2, 3.4, 3.5]. The accepted model of injury prevention first defines the extent and severity of the injury problems and then establishes the mechanisms of injury so that preventive measures can be put in place. Using this model, the International Paralympic Committee has been able to work with sports federations to implement the research outcomes. The research also demonstrated the improvements required to better safeguard

Impact case study (REF3b)

Paralympic athletes through enhanced safety preparation for events and post-injury care pathways [3.2, 3.5].

Translation and intervention: The translation of the research has been integrated with the academic research through key collaborations with sporting organisations and participants as discussed in REF3a. In the 1990s, the UoB was contracted by four sports as part of the UK's Sports Science Support Programme, to undertake applied research for sports performance and assessment.

Research on heat cooling amongst Paralympic athletes was funded in 2003 by UK Sport to enable UoB researchers to work with the British Paralympic Association to develop heat and acclimatisation strategies for use in the Athens 2004 and Beijing 2008 Summer Olympic Games. Further funding from UK Sport enabled WEBBORN to be part of a multi-disciplinary Beijing Acclimatisation Group that, between 2006 and 2008, developed the acclimatisation strategy for the 2008 Summer Paralympic Games.

This research on injury occurrence at the 2008 Summer Paralympics was linked to the first Injury Survey conducted by the International Paralympic Committee and was initiated by WEBBORN at the 2002 Winter Paralympics. The survey highlighted that up to 24% of all Paralympic athletes reported an injury during the Games. The success of this first survey led the International Paralympic Committee to repeat it at the 2006 and 2010 Winter Paralympic Winter Games.

Key researchers:

- Jonathan Doust: Lecturer (April 1987–Aug 1988), Senior Lecturer (Sept 1988–Aug 1992), Principal Lecturer (Sept 92–Feb 2000), Professor of Sport and Exercise Science (Jan 2004–to date), Head of School (Jan 2006–to date).
- Neil Maxwell: Lecturer (Sept 1997–Aug 1999) Senior Lecturer (Sept 1999–May 2004), Principal Lecturer (June 2004–to date).
- Peter Watt: Reader (Dec 2001–to date).
- Nick Webbhorn: Principal Research Fellow (April 2004–to date).

3. References to the research

- [3.1] JONES, A.M. and DOUST, J.H. (1996) A 1% treadmill grade most accurately reflects the energetic cost of outdoor running. *Journal of Sport Science* 14 (4): pp.321–7. [Quality validation: output in leading peer-reviewed journal, and a reference point for others.]
- [3.2] WEBBORN, N. and VAN DER VLIET, P. (2012) Paralympic medicine. *The Lancet*, 380 (9836): pp.65–71. [Quality validation: output in leading clinically related journal.]
- [3.3] CASTLE, P.C., MACDONALD, A.L., PHILP, A., WEBBORN, A., WATT, P.W. and MAXWELL N.S. (2006) Precooling leg muscle improves intermittent sprint exercise performance in hot, humid conditions. *Journal of Applied Physiology* 100 (4): pp.1377–1384. [Quality validation: output in leading peer-reviewed journal.]
- [3.4] WEBBORN, N., PRICE, M.J., CASTLE, P.C. and GOOSEY-TOLFREY, V. (2005) Effects of two cooling strategies on thermoregulatory responses of tetraplegic athletes during repeated intermittent exercise in the heat. *Journal of Applied Physiology* 98 (6): pp.2101–2107. [Quality validation: output in leading peer-reviewed journal.]
- [3.5] WEBBORN, N., WILLICK, S. and EMERY C.A. (2012) The injury experience at the 2010 winter Paralympic games. *Clinical Journal of Sport Medicine* 22 (1): pp.3–9. [Quality validation: output in leading peer-reviewed journal.]

4. Details of the impact

Safeguarding Paralympian well-being: UoB research on injuries and risk factors has protected the well-being of Paralympic athletes by improving how injuries are monitored, changing acclimatisation strategies, safety rules and equipment design, and enhancing the education and practices of clinicians working with Paralympic athletes. The findings on pre-cooling in Paralympic athletes influenced the strategy for Great Britain's athletes in the Beijing 2008 Olympic Games. The research was adopted in the acclimatisation strategy used by the British Paralympic Association to safeguard athletes from heat stress in Beijing and is identified by the English Institute of Sport as having impacted on the sports performance of athletes during the Games.

Impact case study (REF3b)

Following the Beijing Olympics, the English Institute of Sport has confirmed that this strategy has ongoing use within individual sports, in particular wheelchair rugby and tennis (source 5.1).

Based on empirical evidence collected by WEBBORN at successive Winter Paralympics, there have been rule changes for ice sledge hockey, instigated by the International Paralympic Committee in the 2008 rule book, which require standardised sledge design and the mandatory use of protective clothing (5.2). The rule changes have been followed by a reduction in injuries during the Paralympics and the eradication, thus far, of certain injury types (5.2). Ice sledge hockey produced only one lower limb fracture out of the 40 injuries (2.5%) treated in the 2010 Winter Paralympic Games compared with 4 of 12 (33%) of the injuries in 2002, before the introduction of the regulation change.

WEBBORN's research, along with his advisory roles to the International Paralympic Committee and as Chief Medical Officer to the London 2012 Summer Paralympic Games, have ensured his findings have been disseminated widely to clinicians. The International Paralympic Committee has acknowledged that WEBBORN's work has made a significant contribution to the Paralympic movement in relation to the education of clinicians in the field, resulting in improved medical care. The injury study initiated by WEBBORN in 2002 has now been integrated by the International Paralympic Committee as a standard practice in all future Winter and Summer Paralympics (5.3).

Improving elite athletes' preparation and acclimatisation: The research on pre-cooling as a coping strategy for competition in hot environments has also benefitted elite athletes. The findings were used by the USA Olympic committee to guide its strategy for its athletes competing in the 2008 Beijing Olympic Games (5.4). The USA Olympic Committee's preparation manual that advises coaches and athletes on competing in heat and humidity contains four recommendations, all of them based on referenced sport science research publications written by leading researchers and institutions in the UK and Europe. UoB's research publications underpin three of the four recommendations for cooling strategies, including cooling vests, whole-body immersion and ice packs/towels. The manual notes the recommendations will help to delay and potentially prevent body core temperature from rising to a point where it impairs performance (5.4).

The Brazilian Olympic Committee has also acknowledged the importance of the research, in particular the underpinning research publications [3.3] and [3.4] above, and that this research is currently being used as evidence in devising pre-cooling and heat acclimatisation strategies designed to improve performance in the 2016 Olympics and Paralympic Games (5.5).

Enhancing the training practices of recreational athletes: The innovative findings of the sport science research at UoB have resulted in improvements to the training equipment used by recreational athletes, having an indirect impact on personal fitness. It has also led to changes in the advice given to military personnel and people with disabilities taking part in physical exercise.

The research by Jones and DOUST showing that starting a treadmill test with a 1% gradient brings the same benefits as exercising outdoors has contributed to personal fitness by changing how people are tested and advised in gyms. Most treadmill tests of exercise function for fitness assessment and personal training in sports and gyms use the principles verified in this research and adopt the 1% gradient. The USA Navy refers to the UoB research in online advice to navy personnel on how to maintain personal fitness and recommends adding an incline of 1% when using a treadmill (5.6).

Recreational athletes with disabilities are one of the target audiences for the Peter Harrison Centre for Disability Sport, which has been developing a 'Fit and Healthy Resource for People with a Disability'. WEBBORN has undertaken consultation and research activities that inform a series of recommendations on which this new resource is based. These recommendations have led to changes in how the centre delivers and frames material to ensure that practical resources are available for people with disabilities to engage in recreational physical activity (5.7).

5. Sources to corroborate the impact

- 5.1 Testimonial available from the Deputy Director of Performance at the English Institute of Sport. This confirms that UoB research has been used in the development of the heat and acclimatisation strategy for the Paralympics and is used on an ongoing basis within individual sports, in particular wheelchair rugby and tennis.

Impact case study (REF3b)

- 5.2 International Paralympic Committee (2008). *Ice Sledge Hockey Rule Book*. Rules on sledge design and protective clothing are included on page 22 onwards. Available at: <http://www.blazesports.org/wp-content/uploads/2011/02/Sled-Hockey-IPC-Rulebook.pdf> [Accessed: 11 June 2013].
- 5.3 Testimonial available from the Medical and Scientific Director at the International Paralympic Committee. This confirms that UoB research has been used to inform standard practice at all Winter and Summer Paralympics and has reduced injury.
- 5.4 'Preparation for Competing in Heat and Humidity'. Document presented by the Environmental Physiology Team, Performance Services Division, United States Olympic Committee. This document considers cooling strategies for Beijing. UoB's research underpins three of the four strategies. This document is available on request.
- 5.5 Testimonial available from a Distinguished Knowledge Consultant, Brazilian Olympic Committee. This confirms that UoB research is currently being used as evidence in devising pre-cooling and heat acclimatisation strategies to improve performance in the Rio 2016 Olympics and Paralympic Games.
- 5.6 The 'US Navy' *Treadmill vs Outside Walking* Available at: http://www.med.navy.mil/sites/nhoki/Patients/CommunityHealth/HealthPromo/Documents/Articles/treadmill_vs.htm [Accessed: 11 June 2013]. The US Navy refers to the UoB research in advice to navy personnel on how to maintain personal fitness and recommends adding an incline of 1% when using a treadmill.
- 5.7 Testimonial available from the Peter Harrison Centre for Disability Sport. This confirms that recommendations made by University of Brighton researchers form the basis of the Centre's Fit and Healthy Resource for People with a Disability. Available on request.