Institution: University of Wolverhampton

Unit of Assessment: UOA 26: Sports-Related Studies

Title of case study: "Exercise and quality of life improvements in different populations"

1. Summary of the impact

This case study illustrates the development of novel research materials designed to improve quality of life and performance in different populations. Impact has been achieved through the use of research findings in professional practice, formulation of health-related policies and in the development of new indicators of health and well-being. RCSEP research has been used by international and national health-service organisations (e.g., European League Against Rheumatism, Evidence NHS), industrial establishments (e.g., ArtEZ Conservatoire, Netherlands; Royal Ballet), national governing bodies (British Heart Foundation), and professional bodies (e.g., Dance UK, International Association of Dance Medicine & Science).

2. Underpinning research

Our research team has a unique blend of high-level expertise ranging from international coaching and applied physiology (Koutedakis), elite dance (Wyon), advanced mathematics and statistics (Nevill), to clinical physiology (Metsios) and sport science (Cloak). These areas of expertise have been combined in studies aiming to improve health outcomes and quality of life in selected populations, and minimise the costs of disease and injury treatment via novel physical activity interventions. Our success and international recognition can be confirmed by the frequent use of our results by national and international bodies in the following areas:

Chronic Disease: RCSEP research has helped identify factors, such as specific medication dosage, genetic polymorphisms (Panoulas et al., 2008, Panoulas et al., 2009) and physical inactivity (Metsios et al., 2008, 2009, 2012) that may lead to increased risk for heart disease in patients with rheumatoid arthritis. Our current research, partly funded by the Medical Research Council, focuses on behavioural interventions to improve physical activity adherence, reduce the risk of cardiovascular disease, and assess the cost effectiveness of specific exercise interventions.
Smoking: Despite efforts by Governments world-wide, smoking remains a serious health hazard with enormous quality-of-life and economic implications. Our innovative work in this area demonstrated, for the first time in humans, that even acute exposure to second-hand smoke causes detrimental health effects, including respiratory, cardiovascular, immune and endocrine (Flouris et al., 2009). We are one of the very few research teams in Europe working in this area (Stavropoulos et al., 2008; Flouris et al., 2009, 2010, 2012; Metsios et al., 2010).
Dance Science: RCSEP research has aspired to reduce injury incidence and improve performance in elite dancers. We verified that RCESP developed interventions reduce injury incidence by about 50% (Allen et al., 2013). In conjunction with Birmingham Royal Ballet (BRB) and Harlequin Floors Plc we examined the BRB's dance floors and the stages that they tour on (Hopper et al., 2013). This led to Harlequin developing a travelling stage for BRB that mimics the mechanical properties of their rehearsal studios, thereby reducing injuries. In a separate strand of research, RCSEP have demonstrated vitamin D deficiency among dancers during winter periods; a subsequent controlled intervention study revealed improved muscle function and reduced injury occurrence in dancers on vitamin D supplementation (Wyon et al., 2013). As a result, companies, including the Royal Ballet, have implemented vitamin D supplementation programmes for their dancers. RCSEP are one of the most well-recognised dance-science research teams worldwide with more than 30 publications in the last 2 years, partly the product of established collaborations with hospitals (e.g., Royal National Orthopaedic Hospital, London), research institutions (e.g., Institute of Human Performance and Rehabilitation, Greece) and industrial establishments (e.g., ArtEZ Conservatoire, Netherlands, Harlequin Plc and SunVit).

Key Researchers: Yiannis Koutedakis, Professor in Applied Physiology, 1992-present; Alan Nevill, Professor in Research 1999-present; Matthew Wyon, Professor in Dance Science, 2002-present; George Metsios, Reader in Clinical Exercise Physiology, 2007-present; Ross Cloak, Lecturer

2010-present.

3. References to the research

1. Metsios GS, Stavropoulos-Kalinoglou A, Veldhuijzen van Zanten JJCS, Treharne GJ, Panoulas VF, Douglas KMJ, Koutedakis Y, and Kitas GD. (2008). Invited Review: Rheumatoid Arthritis, Cardiovascular Disease and Physical Exercise: A Systematic Review. Rheumatology 47(3), 239-48, DOI: 10.1093/rheumatology/kem260 (Impact Factor: 4.2).
2. Panoulas VF, Douglas KMJ, Milionis HJ, Metsios GS, Stavropoulos-Kalinoglou A, Nightingale P, Kita MD, Elisaf MS, and Kitas GD. (2008). Long-term exposure to medium-dose corticosteroid therapy associates with hypertension in patients with Rheumatoid Arthritis. Rheumatology 47(1), 72-5, DOI: 10.1093/rheumatology/kem311 (Impact Factor: 4.2).
3. Flouris AD, Metsios GS, Carrillo AE, Jamurtas AZ, Gourgoulianis K, Kiropoulos T, Tzatzarakis MN, Tsatsakis AM, Koutedakis Y (2009). Acute and Short-term Effects of Secondhand Smoke on Lung Function and Cytokine Production. American Journal of Respiratory and Critical Care Medicine 179(11), 1029-33, DOI: 10.1164/rccm.200812-1920OC (Impact Factor: 11.0).
4. Flouris AD, Metsios GS, Jamurtas AZ, Koutedakis Y (2010). Cardiorespiratory and immune response to physical activity following exposure to a typical smoking environment. Heart, 96(11): 860-4, DOI: 10.1136/hrt.2009.190744 (Impact Factor: 5.0)
5. Wyon MA, Koutedakis Y, Wolman R, Nevill AM, Allen N. (2013). Effect of vitamin D supplementation on muscular strength and power indices and injury incidence in elite ballet dancers. Journal of Science and Medicine in Sport. DOI: 10.1016/j.jsams.2013.03.007, (Impact Factor: 2.9).
6. Hopper L, Allen N, Wyon M, Alderson J, Elliot B, Ackland T. (2013) Dance floor mechanical properties and dancer injuries in a touring professional ballet company. Journal of Science and Medicine in Sport. DOI: 10.1016/j.jsams.2013.04.013 (Impact Factor: 2.9).

4. Details of the impact

The impact of research produced by this research group can be evidenced as follows:

Use of research findings by professional bodies to define best practice and formulate policies

a) RCSEP work has been adopted by national and international bodies for revising clinical practise regarding: i) the use of physical activity as medicine, and ii) specific cardiovascular disease parameters, namely hypertension. Two publications (Metsios et al., 2008, Panoulas et al., 2008) have been used by the European League Against Rheumatism and the Evidence NHS, respectively, to develop best practice and formulate policies. The former research output, suggesting lifestyle changes for the management of chronic inflammatory disease, has also been adopted by the Scottish Intercollegiate Network, a branch of the NHS quality improvement. These events have triggered keynote presentations to practitioners (e.g., Excellence in Rheumatology, Istanbul, 2011) and invitations to increase awareness in patient groups (e.g., Cancer/Chronic Inflammation Patient Focus Groups: 800+ attendees).

b) Work on the effects of exercise on cardiovascular outcomes (Metsios et al., 2008, 2009, 2010) and the cost-effectiveness of physical activity interventions (Metsios et al., 2011) in patients with chronic inflammation, has led to the: i) adoption of exercise training in clinical practice, and ii) development of a referral scheme for this specific population. These findings have also led to economic/commercial impact that benefited established organisations (e.g. Action Heart) in improving their practises.

c) Part of our work (Gould et al., 2013) has contributed to the development of an exercise referral scheme for patients with breast cancer, in collaboration with Aston University, the Dudley Group of Hospitals - NHS Foundation Trust, and Action Heart.

Development of new indicators of health and well-being

d) RCSEP research focuses on the acute effects of passive smoking on lung function and the

duration of system disruption. Results demonstrating, for the first time in humans through standardised protocol, that acute exposure to second-hand smoke causes marked increases in inflammatory cytokines which remain elevated for at least 3 hours after exposure (Flouris et al., 2009), have been adopted by health and policy-making organisations. These include Action on Smoking and Health for a 2011 report on second-hand smoke, and the European Agency for Safety and Health at Work in advice for non-smokers (2012).

e) Additional information on the duration of acute – as opposed to prolonged – health effects of passive smoking (Flouris et al., 2010) has been included in on-line resource packages of international organisations including the WHO Collaborating Centre for Housing and Health (2010), Cancer Council Victoria, Australia (2011) and Learn Through Evidence Action and Reflexion Networks, Canada (2011). Further outputs on this research area have been reviewed by ProCor, a global network promoting cardiovascular health (Flouris et al., 2010), and included in a 2012 British Heart Foundation policy statement (Metsios et al., 2011).

Use of research findings in the conduct of professional work or practice

f) Based on the dissemination of our research through conferences and peer-reviewed publications (Allen et al., 2013, Wyon et al., 2013), elite dance companies (e,g., Royal Ballet) and vocational dance schools (e.g., Elmhurst Dance School, TheaterSchool, Amsterdam, Holland) have incorporated supplemental training into their timetables and invested in fitness facilities; they also screen their dancers for vitamin D deficiency. Our research reputation has created opportunities for co-authorship of the IADMS Safe and Effective Dance Practice qualification and for the development of dance practitioner focused review articles.

g) RCSEP research (Allen et al., 2012, 2013) has contributed to the establishment of the National Institute of Dance Medicine and Science with the University of Birmingham, the Royal National Orthopaedic Hospital, Dance UK and Laban Conservatoire. Wolverhampton is the leading research institute in the partnership. The Institute has informed NHS service provision with a specialist dance medicine clinic at the Royal National Orthopaedic Hospital. A similar service is currently planned at Queen Elizabeth Hospital, Birmingham.

h) Professor Wyon has introduced whole body vibration training to English National Ballet (ENB) as part of their preparation. This has led to a promotional deal between ENB and PowerPlate with Professor Wyon developing a "dancer programme" for all health and fitness clubs that use PowerPlate for vibration training (e.g. Virgin Active).

i) Industrial impact can also be evidenced by the collaboration between Harlequin Floors Plc, Birmingham Royal Ballet and RCSEP that has led to the development of new flooring infrastructure, with the aim to reduce injury in elite dancers (Hopper et al., 2013). This has also led to Harlequin Floors Plc to sponsor the National Institute of Dance Medicine and Science.

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

1. The Scottish Intercollegiate Guidelines Network used our work to suggest exercise for the management of rheumatoid arthritis (issue 123, 2011; p.26, ref #84).
   The Evidence Based NICE Guidelines (published in 2009 on line; see references to reliable up-to-date systematic reviews) have recommended our paper as a reliable source on exercise and cardiovascular disease in patients with chronic inflammation.
   (Linked to Section 4a and 4b)

2. The European League Against Rheumatism adopted our work on steroid dosages for the management of this disease in the 2010 evidence-based recommendations and official guidelines for rheumatoid arthritis (ref #97.)
   (Linked to Section 4a).

3. Action on Smoking and Health (ASH) established in 1971 by the Royal College of Physicians in a 2011 report on second hand smoke (p. 18, ref #3)
   European Agency for Safety and Health at Work (Advice for non-smokers on health effects

(ref #7)
(Linked to Section 4d)

4. WHO Collaborating Centre for Housing and Health (2010, p11); Cancer Council Victoria, Australia, Tobacco in Australia (2011, p. 32, ref #3); LEARN (Learn Through Evidence Action and Reflexion Networks), Canada (2011, p. 11, ref #11); ProCor, a global network promoting cardiovascular health in developing countries.; British Heart Foundation Policy Statement (ref #14)
(Linked to Section 4e)

5. Gaby Allard, Director, ArtEz School of Dance, Arnhem, The Netherlands (email: g.allard@artez.nl) Introduced periodization and supplemental training into the school that has reduced injury incidence.
(Linked to Section 4f)

6. Helen Laws, Manager, National Institute of Dance Medicine and Science (email: helen@danceuk.org). Impact of NHS Dance Injury Clinic and effect of University of Wolverhampton's research on wider dance industry, IADMS qualification and review articles for teachers.
(Linked to Section 4g)

7. Derrick Brown, The Netherlands Council for Culture/Committee theatre/Sub-committee dance; National Ballet, Amsterdam (email: dutchderrick@gmail.com). Effect of University of Wolverhampton's research on international dance industry: supplemental training, injury prevention, vitamin D supplementation.
(Linked to Section 4f, 4h)

8. Research has resulted to the Safe and Effective Dance Practice qualification for IADMS and to the development of dance practitioner focused information.
(Linked to section 4f)

9. Harlequin Floors Plc have used our research (Hopper et al., 2013) to develop novel dance floors, which comply with the range of force reduction values required by the European Sport Surface Standards, with the aim to reduce injury in elite dancers.
(Linked to Section 4i)