Sports and exercise science and medicine: building on the Olympic legacy to improve the nation's health

A response from The Physiological Society to the House of Lords Science and Technology Committee

The Physiological Society is a learned society which brings together over 3000 scientists from over 60 countries. Physiology is the study of the normal functioning of genes, cells, tissues and organs and how these in turn influence the whole animal or person. Consequently some physiological research needs to be undertaken on living animals or people so as to integrate the insights that come from studying isolated cells and tissues. Working with living animals or people requires additional skills in the care and welfare of the experimental subjects, on top of the underlying investigative skills needed by all researchers. For animals that combination is generally referred to as 'in vivo skills'.

Since its foundation in 1876, the Members of The Physiological Society have made significant contributions to the knowledge of biological systems and the treatment of disease. Our aims are to support physiologists - from researchers starting out in the field to those that are more established in their career, promote the discipline to ensure it remains at the forefront of biological and medical research, and to raise awareness of physiology among non-specialists. A key focus of our work is to ensure physiology remains an attractive career option and we work with teachers, lecturers and researchers from both academia and industry to achieve this.

Q1. How are advances in basic understanding of physiology, biomechanics, genetics, nutrition and other disciplines applied to improving the performance of athletes (both elite and non-elite)?

1. Fundamental scientific research underpins our current knowledge of the mechanisms of the body, e.g. understanding of how muscle functions has been advanced by studies in physiology, biochemistry and nutrition. Moreover, performance of athletes can gradually be improved by advances in knowledge - for example, understanding how the human body responds to different exercise stimuli, and the time-course of these responses, may act to guide training programmes.
2. Whilst there is significant potential for fundamental scientific research to feed into performance enhancement of both elite and non-elite athletes, this potential is often not fulfilled. Instead, as with the translation of many academic fields, a gap exists between the cutting edge of fundamental research and the application of knowledge acquired. In order for more effective translation, better incentives need to be created for scientists engaging in fundamental research (including integrative human and exercise physiology), applied sports scientists, and both coaches and athletes to work more closely together. Increased incentive for academics may be provided by creation of a funding stream to be utilised to investigate the methods and mechanisms to use basic science to improve athletic performance. Other incentives may be provided by more obvious inclusion of performance enhancement in the impact criteria of the Research Councils and the Research Excellence Framework (REF). Whilst we can't speculate what may act as incentive for coaches and athletes, it seems likely they would be deterred by a lack of obvious direct benefits from participating in blue-skies research.
3. More obvious inclusion of sports enhancement when judging research impact may help mitigate problems surrounding the clustering of research conducted with elite athletes. This research takes place in only a few centres cross the UK. Whilst this may be preferable to athletes, there is no

guarantee that centres focussing upon research with elite athletes are also at the cutting edge of basic science, nor that the sports science taking place within these centres are applying advances in fundamental science.

4. There are some questions as to the applicability of fundamental research with respect to performance enhancement. For reasons explained below, much of the fundamental research pertinent to athletic performance is conducted with active but non-elite subject groups. The applicability of research to elite (Olympic medal) performers is questioned, and it is impossible to prove this either way without active and extended cooperation with elite athletes.

Q2. How robust is the application of science in this area? For example, is it possible to conduct research within a training environment?

5. As with any area of research, the quality of science conducted within the fields of exercise physiology, sports science and sports medicine is variable. Additionally, the research covered by these broad fields is wide-ranging, making it hard challenging to define how robust the application of science may be.
6. Conducting robust and high quality research with elite athletes and elite athletic populations during training can be difficult; the coach and athlete have the primary focus of fulfilling athletic potential, rather than conducting blue skies research. The risk of accidentally reducing performance is often felt to be a risk not worth taking, and as such, work with elite athletes is typically observational in nature. Additionally, concessions can often be made to athletes which decreases the reliability and robustness of the trials conducted.
7. Much of the research taking place in these fields is conducted upon either sub-elite athletes, within the laboratory environment upon healthy active volunteers, or utilising clinical populations. These research findings can subsequently be applied to before to elite athletes. However, translation of research from sub-elite to elite athletes can be complex; enhancing the performance of the former is typically easier than the latter, as the latter are usually operating near their maximum capacity.
8. It can be tricky to ensure scientific control of extraneous variables in a training environment than it can be within the laboratory. Whilst it is possible to utilise training environment related data, this must be conducted utilising projects larger in scale than the current small case-study type analyses currently funded. This will help ensure that increased rigor permeates the field.

Q3. How is this research relevant to improving the health of the wider public?

9. The study of exercise and its application to disease prevention and rehabilitation has significant benefits to the health of the wider public. Any research that increases the understanding of human physiology is beneficial; improved understanding of elite performance physiology , being located on one extreme of a continuum of human states (from elite, through the normal range to various disease states) can provide unique insight into physiological mechanisms of relevance to heart disease, respiratory disease, ageing, muscle wasting, obesity, diabetes. This enables a trickledown effect which modifies exercise knowledge in non-elite populations.
10. Whilst there is a wealth of epidemiological research linking health and physical activity, there are far fewer intervention studies actually proving the benefits of exercise to clinical populations. Such studies are now being funded and it is critical that investment continues to be focused in this area of exercise science. This will enable generation of data that may guide personalized prescription of exercise.
11. There are problems relating to access to funding to enable high quality research in sports science and performance enhancement), and it is felt the focus of exercise physiology and sports science

is often upon health rather than sports science. This means translation more typically travels from fundamental research on clinical to application upon athlete populations.

12. However, it is felt that the research findings from this work are not always translated to their full potential, for a number of reasons discussed in the answers to question 7 and 9 below, including but not limited to a lack of incentive for clinicians and researchers to work together, and a lack of appreciation of exercise physiology within mainstream medicine.
13. In addition, study of elite athletes may have limited direct applicability to the health of non-sporting populations. Whilst such research may provide major indicators for health-directed exercise, these indications should always be confirmed with appropriate populations; confirming applicability of age, gender and pre-existing health conditions.

Q4. What is the role of exercise in improving health, as a preventative measure, and as a treatment provided or commissioned by the NHS for illnesses and chronic conditions?

14. Exercise is not utilised to its full potential by the NHS. This is despite fairly conclusive evidence that insufficient physical activity is highly detrimental to long term individual and public health. In addition, exercise can prevent or delay the onset of many chronic disorders, including cardiovascular conditions, and this is far less costly than subsequent treatment with pharmacological agents or surgical intervention.
15. It is felt that GPs and other health practitioners under-prescribe exercise as an intervention. One reason for this is that health practitioners typically lack understanding of the benefits that may be provided by exercise. This is partially due to exercise physiology and sports science often not featuring on the undergraduate medical curriculum.
16. There are concerns that funding for clinical trials investigating the use of exercise is sparse, and this is felt to be partly due to the fact that use of exercise as a therapy may come into conflict with pharmacological options funded by industry, and that there is no specific funding . This is in spite of the fact that many exercise studies will in fact help identify potential therapeutic targets through highlighting the physiological pathways that are involved in response to sedentary behaviour/environmental challenges.
17. It is also important to ensure that there is an increased amount of robust research carried out. As mentioned in response to Q3 (above), whilst there is a wealth of epidemiological research linking health and physical activity, there are fewer intervention studies. Generation of data from large-scale and long term projects is important to show cause and effect, and to help identify specific populations for whom certain exercise based interventions are beneficial.

Q5. How is sports and exercise science research co-ordinated? Who sets the research agenda?

18. There is no national research agenda in terms of sports science and exercise. However there are a number of organisations including industry, with directed agenda. Research into specific aspects of sports performance is occasionally instigated by several National-level organisations, including Sport England and the English Institute of Sport (and the devolved counterparts), as well as the governing bodies of individual sports occasionally instigates research into specific aspects of sports performance.
19. Research conducted is largely determined by funding bodies; be this Government Departments, Research Councils, medical charities or industry. In addition, individual academics may have access to monies from the QR funding stream.
20. There are concerns about a lack of support provided by the Research Councils for these fields of research. There is a perception that there are insufficient integrative human physiologists on the

funding boards. This impedes the financing of high quality research into human physiology, upon which much of the more applied sports science is based.

21. The Research Councils have also historically been less than supportive in the applied sports science end of the spectrum. There is no specific research council home for sports enhancement or sports science, and as such, performance focussed work is largely driven by individual interests or potential commercial interests. Whilst this lack of funding can encourage collaboration between sports scientists and clinicians, with the former having to rely upon medical charities and to a lesser extent, research councils, for funding. However, these collaborations are the result of individual initiatives, rather than being part of a grand strategy.
22. There is a strong sense that far more organisation and co-ordination across sport-sciences centres is required, in order to deliver high quality data (large sample sizes), rather than competing with each other.

Q6. Are health professionals involved in setting the research agenda for sport science and vice versa?

23. There is no specific, national research agenda for sports science, and as such there health professionals are not involved this. In addition, there is a lack of communication between health professionals and sports scientists, and a lack of knowledge and understanding of exercise science within the mainstream medical community. This leads to many health care professionals underestimating the possible benefits of exercise in the prevention of chronic disease and as a possible therapy. Without suitable knowledge to prescribe such, it seems unlikely that health care professionals should have much of a role in guiding the agenda of future research.
24. This, however, is not to say that if barriers between the two communities could be broken down effectively, that there shouldn't be greater integration in terms of development of a research agenda designed to increase the knowledge and understanding of the human body. In addition, we should ensure that the international leaders we have in sports and exercise science in the UK ought to have a greater role in setting the medical education agenda.

Q7. How are findings from sports science research, and sports and exercise medicine, used to develop medical treatments and public health interventions? Is this done effectively?

25. There is no national strategy or structure for the translation of these research findings into medical treatments and public health interventions. As such, development doesn't take place frequently and is neither as effective as it could nor ought to be. With no funding structure for this translational work, success depends upon the funding of individual grants, or work with obvious commercial potential, which can gain industrial support
26. Effective development of medical treatments occurs through follow on studies, for example in university departments with infrastructure for translation. This may include the presence of a suitable breadth of academics, or where there are established collaborative links with clinicians. Alternatively the development of medical treatments and public health interventions may be led by clinicians sufficiently engaged with the literature so as to pick up upon advances in sports and exercise science.
27. This development process could be co-ordinated much more effectively. It is felt that whilst the NIHR does a good job, it does not fully integrate sports science approaches, and their potential application to health, in calls.
28. In addition, the same issues are faced as with the translation of any fundamental sciences into medical treatments. There are insufficient formal links between the NHS, the Department of Health and academic researchers. Additionally, there is a lack of career paths for research scientists within the NHS, including those with interest in sports science, as well as excessive bureaucracy within the NHS.

29. However, it must be noted that there are some successes in the translation of sports and exercise medicine into medical treatments and public health interventions. An example of translation is the €6M EU investment in Metapredict.eu, which partly stems from the exercise sciences studies of Gibala and Professor Jamie. Following from studies indicating that short/sharp bursts of exercise could effectively control diabetes and cardiovascular disease risk factors, Professor Timmons lab now has large intervention studies funded looking at-risk populations (obese) and integrating 'OMIC' screening to also yield personalized diagnostics. This relies heavily upon the early exercise science studies and additionally highlights the importance of well-funded human physiology laboratories in the UK

Q9. Are the findings from sports and exercise science research, and sports and exercise medicine, translated effectively by the NHS and Department of Health? If not, what are the barriers to translation and how could these be addressed?

30. Whilst there is world-class research into sports/ exercise science and medicine taking place within the UK, there is no existing national co-ordinating structure to translate findings, nor is there any research funding readily available for this. These barriers need to be addressed to fulfil the potential for development of innovative and low cost approaches to maintaining and improving health.
31. Moreover, there needs to be increased communication between health practitioners and scientists working on fundamental research as well as applied sports science.
32. As with many fields of research, there is a significant problem relating to a lack recognition and career pathways for research scientists in the NHS. Whilst with respect to this inquiry, ensuring improved careers for research scientists and clinicians with an interest in exercise science would help, the same requirement holds true for other biomedical related disciplines.
33. It is felt health professionals in general underappreciate the health benefits of regular exercise, with practitioners being more concerned with treating existing disease rather than preventative medicine. It is felt that focussed training of medical and health professionals (including short courses providing updates to those qualified), as well as ensuring the integration of more exercise science into the medical programme, would equip these practitioners with the correct knowledge to prescribe exercise correctly.