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

Report

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SUMMARY

In this short inquiry we asked two questions: how robust is the research and evidence base for improving the performance of elite and non-elite athletes; and how can this knowledge be translated into treatments and preventative interventions to improve the nation's health? We focused on biomedical research that could enhance the performance of the individual. The context for our inquiry was the London 2012 Summer Olympic Games and the Government's commitments to the following legacies: to support the performance of elite athletes (measured by medals won at the Games); and to encourage the nation to be "healthier, happier and more active".

Science applied to the fields of sport and exercise is referred to as "sport and exercise science" (SES), and medical treatment and prevention of illness related to exercise and sport are referred to as "sport and exercise medicine" (SEM). Although this inquiry focused on sport as a form of physical activity, other forms of activity such as recreational walking and cycling, gardening and housework are also potentially important in improving people's health.

Quality of science

The evidence we received indicated that it is difficult to carry out high quality research on elite athletes. This is because sample sizes are small and there are no control groups for experimentally testing the effects of interventions to improve performance. Therefore, research on elite athletes is generally observational and anecdotal; at best it describes what, but does not explain why. We were presented with little evidence to suggest that the enhancement of the performance of elite athletes is generally based on strong biomedical science, nor that the latest advances in relevant areas of biomedical research are consistently applied to this work.

Given the difficulties associated with conducting research with elite athletes, the importance of a two-way flow between observations from elite athletes and rigorous research conducted on non-elite athletes and the wider public is all the greater. Neither UK Sport, the agency charged with ensuring the highest possible performance of the UK's elite athletes, nor their sponsoring Department, the Department for Culture, Media and Sport, were able to demonstrate that they have rigorous, independent methods for ensuring that the science they rely on is of high quality.

Health benefits for the wider population

There is good international evidence that physical activity improves health in relation to a wide range of chronic diseases, although the underpinning mechanisms by which these benefits are brought about are not well understood. The majority of witnesses, although not all, agreed that, in principle, research on athletes by sports scientists could help provide health benefits for the wider public, as this could aid the development of preventative measures, treatments for members of the public who exercise infrequently (for example, weekly rather than daily), and inform the development of new interventions based on knowledge of physiological responses. However, there is relatively little "trickle-down" at the moment.

Barriers
The evidence we received suggested that barriers preventing the treatment of ill health by exercise include lack of awareness by health professionals, inadequate training and guidance for these professionals, and lack of confidence in exercise referral schemes. In a survey of 48 London GP practices, no GP was aware of the latest physical activity guidelines.

We were also surprised, and disappointed, by the apparent lack of joined-up thinking in Government about the Olympic health legacy. The Sports Minister, Hugh Robertson MP, told us that his interest was in increasing participation in sport rather than improving the nation's health, the latter being the responsibility of the Department of Health. The Government need to take a consistent approach to health, physical activity and sport, and we recommend that they look to international models to learn from best practice.

Leadership
As part of the Olympic legacy, the Department of Health has set up a National Centre for Sport and Exercise Medicine (NCSEM). We welcome this development. We are concerned that the funding for this is a one off £30 million capital investment, and there is no strategy for the long term sustainability of the NCSEM, nor is the role of the Centre clearly defined. We conclude that there is a need for greater leadership, particularly to improve the quality of research, if sport science research is to be more effective in both improving the performance of elite athletes, and if that knowledge is to be translated into public health benefits. Without this leadership, the opportunity provided by the Olympic legacy could be lost.

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

CHAPTER 1: INTRODUCTION

Purpose of the inquiry

1. With the backdrop of the London 2012 Summer Olympic and Paralympic Games, the Committee decided to conduct a short inquiry into sport and exercise science and medicine. Our purpose was to investigate two fundamental questions:

   - how robust is the research and evidence base for improving the performance of elite and non-elite athletes (in a wide range of sports)?
   - how can this knowledge be translated into treatments and preventative interventions to improve the nation's health?

Background

Olympic and Paralympic health legacy

2. The London bid to host the 2012 Summer Olympic and Paralympic Games promised to "offer more than just 17 days of spectacular sport";[1] and, in 2005, the London 2012 bid committee made a commitment to deliver a lasting legacy.[2] In May 2010, the *Coalition Agreement* said, in relation to the Games, that the Government would "urgently form plans to deliver a genuine and lasting legacy".[3] Later that year, the Department for Culture, Media and Sport (DCMS) published a document entitled *Plans for the legacy from the 2012 Olympic and Paralympic Games*. It focused on four areas of potential legacy:

   - "to increase grass roots participation" in sports "particularly by young people", "and to encourage the whole population to be more physically active";
   - "economic growth";
   - "community engagement" to "bring people together over a national event"; and
   - "regeneration in East London".[4]

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1 http://www.london2012.com/mm/Document/aboutus/General/01/22/85/87/singapore-presentation-speeches.pdf

2 *Ibid.*

3 Cabinet Office: *The Coalition: our programme for government*, May 2010.

4 DCMS: *Plans for the legacy from the 2012 Olympic and Paralymic Games*, December 2010.

3. Dame Tessa Jowell MP, former Olympics Minister and member of the bid committee, explained that the (then) Government had a "driving ambition" to host "the first Olympic Games which could point to a public health legacy". The goal of increasing participation in sport was "not just about increasing participation in sport for the sake of it ... it was also to tackle one of the most serious health epidemics facing the UK, that of obesity".[5] The important health benefits of physical activity underpin the London 2012 Olympic and Paralympic Games legacy commitment: "the nation will be healthier, happier and more active".[6] This legacy commitment is of particular significance not only because of the increasing evidence testifying to the risks associated with sedentary lifestyles,[7] but also because, according to the Department of Health (DH), the costs of providing medical care as a consequence of the UK's physical inactivity "epidemic" are not sustainable. They estimate that the direct cost of physical inactivity to a Primary Care Trust is £5 million a year and that the direct and indirect costs of physical inactivity in England are approximately £8.2 billion a year.[8]

4. A further aim of the Olympic legacy is "maintaining world-class performance" of the UK's elite sportsmen and women.[9] UK Sport, the UK's high performance agency, seeks to improve the performance of the UK's elite athletes. They work with over 1,400 elite athletes to increase the UK's chances of success in major sporting competitions and one aspect of this work, through their research and innovation team, is sport science.[10]

What is physical activity?

5. DH define physical activity as including "all forms of activity, such as everyday walking or cycling to get from A to B, active play, work-related activity, active recreation (such as working out in a gym), dancing, gardening or playing active games, as well as organised and competitive sport"(see Figure 1 below).[11]

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5 D Campbell: 'Will London's Olympic public health legacy turn to dust?', *British Medical Journal*, June 2012.

6 London 2012: *Response to the questionnaire for cities applying to become Candidate cities to host the Games of the XXX Olympiad and the Paralympic Games in 2012*.

7 NHS: *Sport and Exercise Medicine: A Fresh Approach*, April 2012. By "sedentary lifestyles", we mean, for example, reliance on transport rather than walking, increased number of hours spent watching television or in front of a computer, and the rise in the number of hours spent at a desk rather than in manual labour.

8 *Ibid.*

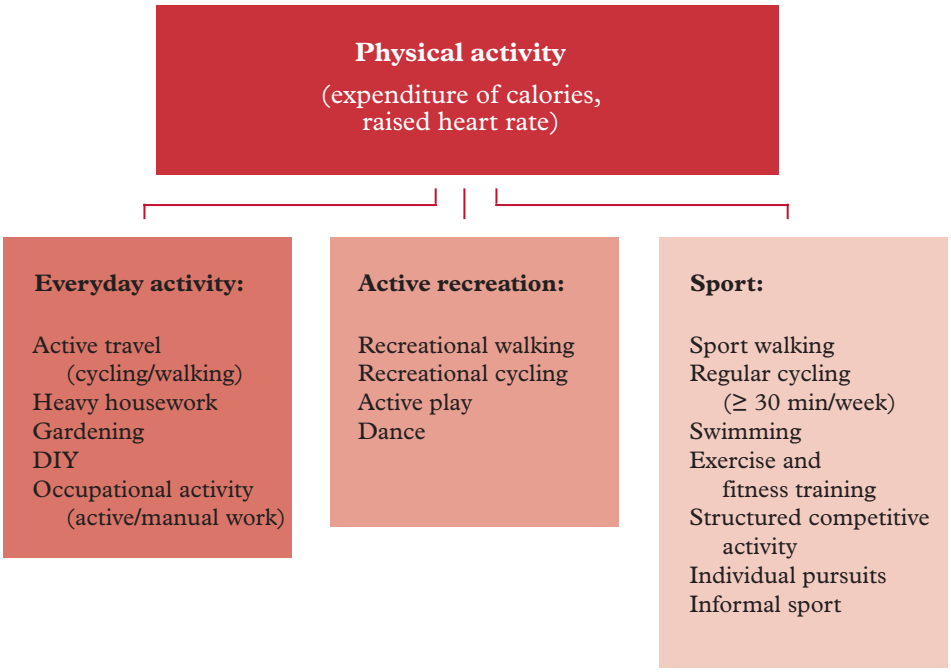
9 DCMS: *Beyond 2012—The London 2012 Legacy Story*, March 2012.

10 UK Sport, Q 70.

11 DH: *Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers*, July 2011.

FIGURE 1

What is physical activity?[12]



National Centre for Sport and Exercise Medicine

6. As part of their commitment to ensure a lasting public health legacy from the Games and to improve support for both elite and non-elite athletes, the Government have promised to expand training, recruitment and services in sport and exercise medicine, and to establish a National Centre for Sport and Exercise Medicine (NCSEM).[13] In funding the NCSEM, DH expect it to "become a hub of clinical and research expertise to:

   - increase exercise in the community;
   - develop strategies to prevent diseases related to inactivity; and
   - prevent, diagnose and manage injuries for both professional and amateur athletes".[14]

   We consider the NCSEM further in paragraph 48.

Areas outside the scope of this inquiry

7. In July 2011, we published a report into behaviour change in which the subject of one of the case studies was interventions, including physical activity, to tackle obesity.[15] To avoid overlap, we have limited the scope of this inquiry to exclude behaviour change where it relates to encouraging participation in sport. Since the focus of this inquiry is the science of improving human performance, we have also excluded technologies and work to enhance sports equipment.

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12 *Ibid.*

13 DH, DCMS.

14 http://www.uclh.org/News/Pages/SportinstitutedriveshomeOlympiclegacypledge.aspx.

15 House of Lords Science and Technology Committee, 2nd Report (Session 2010–12): *Behaviour Change* (HL Paper 179).

Methodology

8. A targeted call for evidence was sent to the Government, its agencies with responsibility for sport, health and research, and the Royal College of Physicians (RCP) in May 2012. The call for evidence was also published on our website. Twenty-three submissions were received. The call for evidence is set out in Appendix 3. In March 2012, we held a seminar on sport science, a note of which is set out in Appendix 4. In May 2012, we held a seminar on the Olympic public health legacy. A note of this seminar is set out in Appendix 5. In June 2012, we held five oral evidence sessions.

Acknowledgements

9. The membership and interests of the Committee are set out in Appendix 1, and those who submitted written and oral evidence are listed in Appendix 2. We are grateful to all those who assisted us in our work.

10. Finally, we are grateful to our Specialist Adviser, Professor Ian Macdonald, Professor of Metabolic Physiology in the Faculty of Medicine and Health Sciences at the University of Nottingham, for his expertise and guidance during this inquiry. We stress, however, that the conclusions we draw and the recommendations we make are ours alone.

CHAPTER 2: THE QUALITY OF SCIENCE UNDERPINNING SPORT AND EXERCISE SCIENCE AND MEDICINE

Sport and exercise science and medicine

11. Sport and exercise science (SES) is the application of fundamental and applied sciences to the sport and exercise environment;[16] and findings from a variety of different areas of science, including physiology, biomechanics, nutrition, genetics and psychology, are applied to the study of sport and exercise.[17] In 2001–07, research income for "sports-related studies" was £31.2 million.[18]

12. Sport and exercise medicine (SEM) has been recognised recently as a specialty by the National Health Service (NHS).[19] It is concerned with "all aspects of health and illness that may prevent a person from engaging in, or returning to, sporting or physical activity".[20] The NHS define SEM as "the management of medical conditions and injury in those who participate in physical activity".[21] The specialty also includes expertise in exercise advice, prescription and promotion for general health, and for those with chronic medical problems.[22] The research subjects of both SES and SEM include elite athletes, non-elite athletes and the wider public. There is some overlap between the two fields.

13. In this chapter, we consider the use of science to improve the performance of elite and non-elite athletes, and the scientific study of physical activity in the wider population. We also explore the relevance of findings from research in SES and SEM to the wider public.

Quality of SES and SEM research

14. Before considering whether SES and SEM research can be translated into public health benefits, it is necessary to consider whether the research is sufficiently robust—in the sense that it is based on accepted scientific methodology—to justify translation. The scientific method involves systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses.[23] Replication of research results and appropriate statistical analysis are necessary before a result is widely accepted.

15. Several witnesses referred to the difficulties of conducting good quality research with elite athletes. A principal difficulty was the limited number of elite athletes to test and, therefore, small sample sizes.[24] Furthermore, many elite athletes are reluctant to allow invasive procedures, such as blood sampling and tissue biopsies, for fear they would interfere with performance.[25] We were told that another common difficulty was creating control groups, because

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16 Based on the definition by the British Association of Sport and Exercise Sciences (BASES) at http://www.bases.org.uk/About.

17 *Ibid.*

18 RAE 2008: *Subject Overview Report: Unit of Assessment 46 Sport-Related Studies*, January 2009.

19 DH.

20 http://www.medicalcareers.nhs.uk/specialty_pages/medicine/sport_and_exercise_medicine.aspx.

21 *Ibid.*

22 *Ibid.*

23 Oxford University Press: *Oxford English Dictionary*, 2010.

24 Q 90.

25 Q 11, RCP.

athletes, and their support staff (such as coaches), were seeking a "competitive edge" and so would not consent to such arrangements.[26] As a consequence, research on elite athletes tends to be descriptive or anecdotal rather than systematic. Given that some of these difficulties are intractable because of the very nature of elite performance, using non-elite athletes offers a more effective alternative subject for research in these fields.

16. A number of witnesses were positive about the quality of research. For example, Professor Myra Nimmo, Head of School of Sport, Exercise and Health Sciences and Professor of Exercise Physiology of Sport, Loughborough University, argued that the quality of SES research, on the whole, was excellent.[27] Colonel John Etherington, Vice-President, Faculty of Sport and Exercise Medicine (UK), and Director, Defence of Rehabilitation and Consultant in Rheumatology and Rehabilitation at the Defence Medical Rehabilitation Centre, Headley Court, said that "the model of the science is very good" in SES.[28] Professor Tim Cable, Director of the School of Sport and Exercise Sciences and Professor of Exercise Physiology, Liverpool John Moores University, was confident of the rigour of science in SES, and gave the examples of the physiological adaptations that can be provoked by certain training regimens, brain behaviour adaptations seen in learning skills, and biomechanical adaptations. He argued these were are all based on sound scientific evidence.[29]

17. Other witnesses, however, suggested that the quality of sport science research was generally weak. The Physiological Society said that an "increased amount of robust research" was being undertaken, but were critical of the quality of research both in SES and SEM.[30] Much of the research presented in our sport science seminar was observational and anecdotal, so the results of such research must be viewed as no more than provisional.[31] Observational research needs to be followed up with rigorous testing of hypotheses in controlled experiments with sufficient sample sizes for statistical analysis. There are voluntary guidelines promoting good quality SES research but it is not clear how widely they are followed.[32] The RCP and Ministry of Defence (MOD) were critical of weak methodologies employed in SEM, and suggested that there was a "focus on more esoteric areas".[33] They pointed to a lack of good quality, large-scale trials, with appropriate outcome measures,[34] which Colonel Etherington summarised as a lack of "rigour in approach to clinical trials in sport and exercise medicine".[35]

18. UK Sport argued that measuring quality of research by its methodology risked ignoring the "end user". UK Sport suggested that other factors had to be considered such as performance impact, adoption of findings, and behaviour change.[36] Professor Greg Atkinson, Professor in Exercise and

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26 Professor Atkinson, Professor Mullineaux, The Physiological Society.

27 See Appendix 5.

28 Q 7.

29 Q 4.

30 The Physiological Society.

31 See Appendix 5.

32 Professor Atkinson, BASES.

33 RCP, MOD.

34 *Ibid.*

35 Q 8.

36 UK Sport.

Human Health Research, Teesside University, and Professor David Patterson, Chair, Institute of Sport and Exercise Medicine and Professor of Cardiovascular Medicine, Centre for Health Informatics and Multiprofessional Education, University College London (UCL), made the case for the value of observational studies.[37]

19. We accept the importance of outcomes, and the merits of observational research as the first step to full scientific investigation. However, if the research in this field is to be of value, it must be rigorous. For example, it should be able to stand-up to the widely used test of peer-review and be of comparable quality to research in fundamental disciplines such as physiology.

20. **During the course of this short inquiry we were presented with little evidence to suggest that the enhancement of the performance of elite athletes is generally based on strong biomedical science. Given the difficulties associated with conducting research with elite athletes, it is important to develop a two-way flow between, on the one hand, observations on elite athletes and, on the other hand, rigorous research on non-elite athletes and the wider public.**

Improving the performance of elite athletes

21. The examples in Box 1 illustrate the quality of science underpinning attempts to improve elite performance.

BOX 1

Examples of use of science to improve elite sporting performance

- Training at altitude has become increasingly popular amongst elite athletes. Exercising at altitude leads to increased ventilation, increased heart rate, decreased stroke volume, reduced plasma volume, and lower maximal aerobic power. This enables athletes to push their limits in training. It is also claimed that the technique, known as hypoxic training, increases the level of haemoglobin and thus the oxygen carrying capacity of the blood. This will help to reverse the effect of altitude to reduce exercise performance. When athletes then return from altitude, they experience performance benefits at sea level.[38] Professor Hugh Montgomery of University College London, who has pioneered much of this work, explained that whilst "we know that it does work", what is less clear are "the reasons why and how to manipulate it".[39]
- Ice baths are increasingly used by elite athletes to accelerate recovery from training. There is limited scientific evidence to support this technique, with no evidence from controlled trials that post-exercise cooling with an ice bath enhances recovery and improves subsequent performance.[40]

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37 Professor Atkinson, Q 90.

38 See Appendix 5, RL Wilber: 'Application of altitude/hypoxic training by elite athletes', *Medicine and Science in Sports and Exercise*, 2007, M Vogt and H Hoppeler: 'Is hypoxia training good for muscles and exercise performance?', *Progress in Cardiovascular Disease*, 2010.

39 Q 11.

40 KL Sellwood, P Brukner, D Williams, A Nicol and R Hinman: 'Ice-water immersion and delayed-onset muscle soreness: a randomised controlled trial', *British Journal of Sports Medicine*, 2007, M Yamane, H Teruya, M Nakano, R Ogai, N Ohnish and M Kosaka M: 'Post-exercise leg and forearm flexor muscle cooling in humans attenuates endurance and resistance training effects on muscle performance and on circulatory adaptation', *European Journal of Applied Physiology*, 2006, Appendix 4.

- The increase in metabolism during high intensity exercise can generate free radicals which can damage mitochondria and other organelles inside muscle cells. In an attempt to counteract this potential free-radical damage there is substantial consumption of antioxidants by athletes. However, evidence from Professor Jose Viña shows clearly that antioxidant supplementation does not have such protective effects and may, in fact, prevent the benefits normally seen with exercise training.[41]
- One aspect of nutritional manipulation which has been shown to be beneficial in terms of performance during prolonged endurance exercise (such as marathon running) is carbohydrate loading. This technique was originally developed in experimental studies in non-elite athletes, and showed that continuing training while on a low carbohydrate diet would deplete the muscle carbohydrate (glycogen) stores, but when followed immediately by 2–3 days of a high carbohydrate diet this would lead to an overshoot of recovery of glycogen (supercompensation) which led to enhanced muscle glycogen levels at the start of an endurance event. This, in turn, ensured a sustained supply of carbohydrate fuel for the muscles and better endurance performance and was subsequently adopted by elite athletes. The specific detail of this regime has been modified over the years with subsequent research on non-elite athletes then applied to the elite, in order to ensure sustained improvement in performance with less extreme dietary manipulations.[42]

Use of the latest developments in science to improve elite performance

22. The UK has internationally recognised expertise in many fields relevant to SES and SEM. For example, Professor Jose Viña, Department of Physiology, University of Valencia, referred to the UK's leading research in fields relating to the improvement of performance, such as metabolic research applied to the physiology of muscle.[43] In this context, we considered whether SES and SEM for elite athletes were being informed by the latest developments in, for example, physiology, biomechanics, genetics and nutrition. Professor Gerta Vrbova, Emeritus Professor of Developmental Neuroscience, UCL, suggested not. She told us that SEM departments are "often poorly equipped" to apply advances in science to problems in their field.[44] The Physiological Society said that although there was significant potential for fundamental scientific research to "feed into" performance enhancement of elite (and non-elite) athletes, that potential was often not fulfilled.[45] **The evidence we received has led us to the view that the latest advances in relevant areas of biomedical research are not being consistently applied to improving the performance of elite athletes. Robust**

41 MC Gomez-Cabrera, E Domenech, M Romagnoli, A Arduini, C Borras, FV Pallardo, J Sastre and J Viña: 'Oral administration of vitamin C decreases muscle mitochondrial biogenesis and hampers training-induced adaptations in endurance performance', *American Journal of Clinical Nutrition*, 2008, MC Gomez-Cabrera, M Ristow and J Viña: 'Antioxidant supplements in exercise: worse than useless?', *American Journal of Physiology*, 2010.

42 E Hultman, and J Bergström: 'Muscle glycogen synthesis in relation to diet studied in normal subjects', *Acta Medica Scandinavica*, 1967, LM Burke: *Sports nutrition* in JW Erdman, IA Macdonald, SH Zeisel (eds): *Present Knowledge in Nutrition*, 10th Edition, 2012.

43 Professor Viña.

44 Professor Vrbova.

45 The Physiological Society.

methodologies must be applied to SEM and SES for them to have maximum effect, and to enable a two-way flow of research between the fundamental and applied disciplines.

Use of science by UK Sport

23. UK Sport is a DCMS arm's length body. They have a research and innovation budget of £7.5 million (for the period 2009–13) from a combination of Government and National Lottery funding,[46] and attract over £12 million in "external funding".[47] We asked Liz Nicholl, Chief Executive of UK Sport, about their approach to science relevant to their remit. She told us that the agency's primary objective was to win more medals in competitions. As a result, their focus was on outcomes stemming from the application of science rather than scientific methodologies used.[48] UK Sport said they relied on the providers of science to do the quality assurance.[49] We were surprised by this since ensuring that robust science is used would increase the likelihood that interventions to improve competitive performance are effective. We note that UK Sport has a science research advisory group to provide "advice on research and development projects" and to evaluate "the effectiveness of projects annually",[50] but, if the science used by UK Sport is to be as effective as possible in improving performance, it must be consistently robust and verified as such. A review in 2005 by the Office of Science and Technology concluded that DCMS needed to satisfy itself of the quality assurance of science by its arm's length bodies, such as UK Sport.[51] Neither DCMS officials nor Hugh Robertson MP, Minister for Sport and the Olympics at DCMS, convinced us that the department has the capacity to undertake this task.[52] **We recommend that DCMS and UK Sport take steps to ensure that the biomedical science UK Sport applies to improving the performance of elite athletes is of the highest quality and meets international peer-review standards that would be applicable in other areas of science**.

24. We were also disappointed by the approach of UK Sport to sharing the findings of research. Little of the agency's work is published in peer-reviewed journals, and many of its results are not publicised in order to protect a competitive edge.[53] We heard one good example of findings being shared: the publication of the findings of a UK Sport workshop on early treatment of muscle strains.[54] But we did not receive evidence to suggest that this type of work is undertaken often. **We recommend that UK Sport should, as a matter of principle, undertake to share its research findings more widely, especially where the research is publicly funded.**

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46 Supplementary evidence from UK Sport.

47 http://www.uksport.gov.uk/pages/research-innovation/.

48 Q 89.

49 Q 70.

50 UK Sport.

51 Office of Science and Technology: *Science review of DCMS*, 2005.

52 QQ 41–42, QQ 135–136.

53 Q 134.

54 http://www.uksport.gov.uk/news/muscle_strain_think_tank/.

Health benefits of physical activity

25. There is a significant body of evidence regarding the health benefits of physical activity and the use of exercise to manage chronic disease. For example, DH referred to research demonstrating that physical activity can be effective in the prevention and management of over 20 chronic conditions, including coronary heart disease, stroke, type two diabetes, cancer, obesity, mental health problems and musculoskeletal conditions.[55] They argued that the research on disease management is robust because it is supported by randomised controlled trials.[56] Professor David Jones, Emeritus Professor of Muscle Physiology, Manchester Metropolitan University, told us about research into the role exercise can play in preventing the development of obesity, diabetes and cardiovascular disease.[57]

26. The Chief Medical Officers' Physical Activity Guidelines are based on a literature review of the latest research into physical activity. Most involves population-level studies that show correlations between physical activity and health outcomes.[58] What is less well understood are the underpinning mechanisms which would explain these effects.[59] Research into increasing our understanding of these underpinning mechanisms could unlock benefits for athletic performance and for public health, in relation to managing illness and disease prevention. For instance, understanding the cellular or molecular processes that underpin changes in muscle mass have applications for both. **There seems to be sufficient evidence to demonstrate a causal link between physical activity and health benefits for a very wide range of diseases. However, the reasons for this link are not well understood. Research to understand these underpinning mechanisms could be of benefit to elite athletes, non-elite athletes and the wider public.**

Relevance of findings from the study of elite and non-elite athletes to the wider public

27. Where there is good quality evidence from the study of elite and non-elite athletes, we considered whether findings from such research in SES and SEM were relevant to the wider public. Some witnesses challenged the relevance of studies of elite athletes to the general population. Professor Sir Steve Bloom, Head of Division for Diabetes, Endocrinology and Metabolism, and Chair of the Academic Section of Investigative Medicine, Imperial College London and Chief of Service for Pathology at Imperial College Healthcare NHS Trust, said: "I cannot see any area of research that has come out of competitive training that is actually helpful to the general population",[60] and Dame Sally Davies, Chief Medical Officer (England) and Chief Scientific Adviser, DH, was "not convinced there is vast transferability".[61] These views were, however, the exception.

28. Colonel Etherington argued that the principles of exercise to produce a physiological adaptation were applicable to the wider public:

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55 DH.

56 *Op. cit. Sport and Exercise Medicine: A Fresh Approach*.

57 Professor Jones.

58 DH, see Appendix 5.

59 See Appendix 5.

60 Q 14.

61 Q 44.

> "whereas the minutiae of the physiological enhancement to get that last 2% to win a gold medal may not be so relevant to the elderly patient with osteoarthritis of the knee, the principles of strength training and general conditioning are".[62]

The RCP provided two examples of research "pulled-through" to benefits for the general population: they suggested that the management of the diabetes of elite sportsmen has begun to inform the principles of diabetic care in the exercising population; and that work with athletes had informed the use of exercise and muscle conditioning to improve back and knee pain in osteoarthritis. They concluded that, whilst there was potential for lessons learnt from the study of athletes to be applied to general population, this was not always happening.[63]

29. Professor Alison McConnell, Professor of Applied Physiology at Brunel University, argued that:

> "by understanding the limits of human performance (for example, cardiac output, muscle blood flow) and by gaining an understanding of how to optimise interventions to achieve specific goals, exercise science can contribute to the development of exercise-related interventions for patients".[64]

The Physiological Society made a similar argument:

> "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".[65]

Professor David Mullineaux, Professor in Sports Science, School of Sport, Coaching and Exercise Science, Faculty of Health and Life Sciences, University of Lincoln, suggested that, although there was great potential to transfer understanding of elite athletes to improve the health of the wider public, this avenue of research was underexplored.[66]

30. **Where there is a good scientific basis, lessons could be learnt from the study of elite and non-elite athletes that have relevance to the wider public. This "trickle down" of research from athletes to public health benefits will be even more valuable where underpinning mechanisms are better understood.**

31. This is a potentially valuable area of research which could have a variety of applications: preventative measures and treatments for members of the public who exercise infrequently (for example, weekly rather than daily); providing underpinning knowledge for more detailed exercise guidance; and developing new interventions based on knowledge of physiological responses. We would hope that research and innovation to support Paralympians also filters through to benefit the wider public. In the next chapter, we consider the barriers to translation and how they can be reduced so as to enable greater "trickle-down" of research to benefits for the wider population.

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62 Q 7.

63 RCP.

64 Professor McConnell.

65 The Physiological Society.

66 Professor Mullineaux.

CHAPTER 3: TRANSLATION OF FINDINGS TO PUBLIC HEALTH BENEFITS

32. In this chapter we consider the translation of findings from SES and SEM research to public health benefits, barriers to translation and possible solutions. By "translation", we mean the informing of health care provision and Government policy by the findings of this research.

Ongoing translation work

33. Both DH and the NHS have made efforts to promote the public health benefits of exercise.[67]

Physical Activity Guidelines

34. The Chief Medical Officers' Physical Activity Guidelines recommend, for example, 150 minutes of moderate intensity exercise (such as brisk walking or mowing the lawn) or 75 minutes of vigorous activity (such as swimming or aerobic dancing) (or a combination of the two) a week for 19–64 year old adults, and make other specific recommendations to children and young people, under fives and those over 65. We note, however, that although these recommendations have been published, there is no strategy for ensuring that the population, or even medical professionals, are aware of them.[68]

SEM specialists

35. The first cadre of SEM specialists are currently being trained—thereby fulfilling one of the Government commitments in the London 2012 Olympic bid.[69] There is some uncertainty about how many posts will be available for them to fill, and there is a risk they will leave the NHS to work in the private sector.[70] But, although the NHS needs to articulate the expected career route for these specialists, we see the development of this speciality as a positive step.

Exercise referral

36. Primary care exercise interventions have been developed.[71] DH contend that these short-term exercise interventions have been used to some effect by GPs.[72] The services were commissioned following an evaluation by the National Institute for Health and Clinical Excellence (NICE) which demonstrated that short interventions offer value for money.[73] However, the evidence we received suggested that there is significant scope for greater use of physical activity as a treatment and preventative measure. Sport England, for example, argued that exercise prescription should "sit alongside" pharmaceutical and surgical interventions. They made the case for a

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67 DH.

68 *Op. cit. Start Active, Stay Active.*

69 DH.

70 QQ 19–20.

71 NHS: *Let's Get Moving—A new physical activity care pathway for the NHS. Commissioning Guidance*, 2009.

72 DH.

73 NICE: *Four commonly used methods to increase physical activity: brief interventions in primary care, exercise referral schemes, pedometers and community-based exercise programmes for walking and cycling*, 2006.

"cultural change ... to improve national physical activity levels" which "should be led by the NHS".[74] Intelligent Health argued that exercise referral provision was "patchy" and highlighted concerns from London-based GPs about a lack of feedback from interventions, and time delays in patients being seen.[75] NHS London's campaign, My Best Move, includes the commissioning of exercise guidance for specific chronic conditions for GPs to refer to in consultations, similar in format to medication reference guides.[76]

Beacon SEM services

37. Pathway clinical commissioning groups (which will be responsible for commissioning services in the reformed health care system) in Sheffield are using "beacon" SEM services to explore further the benefits of SEM services in primary care.[77]

Barriers to translation

38. We have identified several barriers to the translation of findings from sport and exercise research to public health benefits, aside from the primary barrier of quality of research, which we considered in Chapter 2.

Funding for translational research

39. The National Institute for Health Research (NIHR) has responsibility for funding public health research and "research for patient benefit",[78] although some translational funding is provided by charities such as Arthritis Research UK.[79] Lack of funding for translational research and the absence of incentives for private sector funding, were highlighted to us as barriers to translation.[80] Professor Patterson, for example, regretted the absence of sufficient funding, particularly for SEM research.[81] Professor McConnell, MOD, The Physiological Society and RCP all observed that there was little financial incentive for pharmaceutical companies to fund this research.[82] **Given the estimated costs of inactivity (see paragraph 3 above), and the potential benefits of the use of exercise as a preventative measure and treatment for chronic diseases, we recommend that the NIHR and other research funders should stimulate research to translate findings of sport and exercise science and medicine to public health benefits.**

Training for health professionals

40. Institutional barriers within the healthcare system are also preventing translation of research into treatments. Professor Hugh Montgomery,

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74 Sport England.

75 Intelligent Health.

76 DH, Intelligent Health.

77 DH.

78 http://www.nihr.ac.uk/research/Pages/default.aspx.

79 Arthritis Research UK.

80 MOD, RCP, BASES, Professor McConnell.

81 Q 81.

82 Professor McConnell, MOD, The Physiological Society, RCP.

Professor of Intensive Care Medicine and Director, UCL Institute for Human Health and Performance, and seminar participants told us that SEM was not adequately covered in medical training.[83] Anne Milton MP, Minister for Public Health, DH, agreed that there was a need for training for health professionals.[84] Training was also recommended by Arthritis Research UK, Professor McConnell, Professor Vrbova and The Physiological Society.[85] When delivering training in 48 GP practices in 28 London Boroughs, Intelligent Health found that none of the London GPs to whom they presented were aware of the latest Physical Activity Guidelines.[86]

41. It was suggested in our second seminar (on the Olympic public health legacy) that adding physical activity to the GP Quality and Outcomes Framework (QOF), a voluntary incentive scheme for GP practices in the UK which rewards them for "how well they care for patients",[87] would incentivise GPs to increase their knowledge of SEM.[88] Sport England agreed that adding physical activity to the QOF would raise the profile of physical activity,[89] and Intelligent Health also called for its inclusion.[90]

42. Inappropriately prescribed exercise can give rise to significant risks to patient health—for example, certain osteoarthritic conditions can be exacerbated by the wrong forms of exercise—which underlines the importance of adequate training being provided. Colonel Etherington argued that improved information would assist GPs to prescribe exercise.[91] We agree. **We recommend that the NHS, medical schools, the General Medical Council and relevant professional bodies ensure that appropriate training, both at undergraduate level and in continuing professional development opportunities, is available for health professionals to support the prescription of exercise as a preventative measure and treatment, where science supports this. We invite the NHS to consider adding physical activity to the QOF.**

Guidance

43. As well as adequate training, suitable guidance is needed to support health professionals in prescribing exercise.[92] At present, NICE guidelines to support GPs in the treatment of chronic diseases, such as diabetes and heart disease, do not recommend specific types of exercise.[93] We note, however, that NHS London has commissioned Intelligent Health to produce a book on exercise treatment for specific diseases.[94] It would appear, therefore, that there is sufficient scientific evidence to justify NICE reviewing their

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83 Q 20, see Appendix 5.

84 Q 122.

85 Arthritis Research UK, Professor McConnell, Professor Vrbova, The Physiological Society.

86 Intelligent Health.

87 http://www.nice.org.uk/aboutnice/qof/qof.jsp

88 See Appendix 5.

89 Sport England.

90 Intelligent Health.

91 Q 25. Colonel Etherington said: "GPs need to have the information, the information technology tools available to them, and they need to have a referral pathway that they can be confident in".

92 Q 25.

93 Q 30.

94 Intelligent Health.

guidelines for chronic diseases and to improve their guidance about use of exercise as a treatment. **We recommend that NICE assess the quality of research to support the prescription of specific exercises in the management of chronic diseases and, where the evidence supports it, update their guidelines to reflect these findings.**

Quality assurance of exercise professionals

44. The Register of Exercise Professionals (REP) is a scheme to set standards for qualifications and continuing professional development of exercise professionals.[95] It is a voluntary scheme and some witnesses raised concerns about the lack of compulsory professional standards for exercise therapists. The MOD contrasted the absence of high quality training and assurance for civilian exercise therapists with the extensive training given to Exercise Rehabilitation Instructors in the military.[96] RCP suggested that this lack of assurance did not instil confidence and, as a result, GPs were wary of using exercise referral schemes.[97] The British Association of Sport and Exercise Sciences (BASES), similarly, highlighted the absence of a professional registration system for exercise professionals recognised by the NHS.[98] Anne Milton MP was unconvincing in her reply when asked about formalising regulation, simply saying: "we are not very fond of statutory regulation".[99] We were, however, more convinced by her view that "if exercise is used as prescription it is important that, if we are spending public money, we [the Government] are assured that it is well spent and spent by people who have reached an appropriate standard and are achieving a certain quality of service".[100] **We recommend that the NHS and NICE evaluate the most effective mechanism for assuring the quality of service delivered by exercise professionals in exercise referral schemes.**

Government policy

45. The final barrier to translation which we have identified are weaknesses in the Government's approach to promoting physical activity, exercise and sport. There is some cross-departmental work to promote physical activity. For example, DH work with the Department for Transport to promote active travel policy, including walking and cycling.[101] They also work with the Department for Education to promote physical activity in schools.[102] We consider the existence of a Cabinet Sub-Committee on public health to be a positive first step towards joined-up policy,[103] although we did not receive any evidence as to its effectiveness.

46. Despite these positive examples, the Sport and Recreation Alliance argued that there was scope for better integration of sports, health and physical

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95 Register of Exercise Professionals.

96 MOD.

97 RCP.

98 BASES.

99 Q 124.

100 *Ibid.*

101 Q 104, *Op. cit. Start Active, Stay Active.*

102 Q 104.

103 Q 66.

activity policies.[104] The RCP agreed and argued that "sport, health and exercise medicine are interlinked and a positive message of their benefit should be given".[105] The 2010–11 *Active People Survey* by Sport England suggested that participation in sport was no longer increasing.[106] Whilst we have excluded behaviour change from the scope of this report, we would observe that these figures suggest that the Government need to do more to promote physical activity (of which sport is one form). This will require a joined-up approach between departments, and also with local authorities (since local authority Health and Wellbeing Boards will help promote public health under the revised health care system).

47. We were disappointed by the assertion of the Minister, Hugh Robertson MP, that DCMS should not help promote physical activity through sport. He also said: "the baseline for ... the whole sport plans, is driving up participation in sport; it is not a bigger drive on the nation's health".[107] This is at odds with the statement made by Dame Tessa Jowell MP about the Olympic legacy (see paragraph 3 above).[108] Whilst we understand that DCMS had to adjust its sport participation targets, to which reference was made in a National Audit Office report,[109] this does not justify separating sports participation from the physical activity and health agendas. We were further surprised that neither DCMS nor DH could point to policy lessons learnt from international examples.[110] Mr Robertson suggested that the Australian Institute of Sport (AIS) was following the example of the English Institute of Sport's (EIS), and yet the AIS have developed a National Sport Science Quality Assurance Programme "to promote continuous improvement in sports science testing standards in Australia and to help sports science programmes involved in the assessment of athletes to establish and maintain an environment of national standard",[111] from which UK Sport (who own EIS) could learn. **We find it remarkable that DCMS is not concerned with the health benefits of sport (as a form of physical activity). We recommend that the Government take a strong, joined-up approach to promoting the health benefits of exercise and physical activity, and that DCMS play an active part in this. We also recommend that the Government look to international models for improving the quality and application of sport science.**

National Centre for Sport and Exercise Medicine

48. A £30 million capital grant has been given to three consortia to develop the NCSEM.[112] Mike Farrar, Government champion for sport and physical activity and Chief Executive of the NHS Confederation, and Anne Milton MP indicated that the Centre would have to bid for future funding.

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104 Sport and Recreation Alliance.

105 RCP.

106 Sport England: *Active People Survey*, December 2011. This was a self-reporting study of UK adults about whether they participate in sport three times a week for 30 minutes at moderate intensity.

107 Q 130.

108 *Op. cit. Will London's Olympic public health legacy turn to dust?*

109 National Audit Office: *Increasing participation in sport*, May 2010.

110 Q 127, Q 154.

111 http://www.ausport.gov.au/ais/sssm/quality_assurance/.

112 DH.

Many witnesses found this unsatisfactory.[113] The RCP were unsure of the strategic intent of the NCSEM and identified a "risk of disconnect" between the sport medicine and sport science communities, and of the money supporting existing local research rather than a national strategy.[114] Professor Montgomery summed up the current situation as follows: "the money has been put in for infrastructure, but that is not posts or research grants; it is floor space".[115] **Given the level of seed investment made, and the importance of this research, the proposed strategy is unsatisfactory. We recommend that DH clarifies the intended role of the NCSEM and outlines how it will ensure that the work of the Centre will be sustainable.**

Research Council funding

49. The Research Councils fund some research in SES and SEM.[116] For example, the Biotechnology and Biological Sciences Research Council (BBSRC) have two calls for research proposals jointly sponsored by UK Sport which are targeted specifically at understanding and improving elite athlete performance: 'High Performance Sport as a Model for Biological Research', and 'High Performance Sport as a model for the acquisition, retention and retraining of an individual's skill base'.[117] The Medical Research Council's (MRC) research priorities include understanding the roles of physical activity and sedentary behaviour in the maintenance of health and also the prevention of disease.[118] The Engineering and Physical Sciences Research Council have also funded research into use of sensors to improve athletic performance.[119] However, RCP, MOD, Professor McConnell and The Physiological Society expressed concern that there was no lead research council,[120] and the area might fall between BBSRC and MRC.[121] For example, The Physiological Society criticised the lack of integrative human physiologists on funding boards.[122] However, in the light of our finding that there is limited high quality research in these fields it is unsurprising that they do not fund more SES and SEM research. **The NCSEM, sports scientists and sport medical professionals must demonstrate that they can undertake research of the same quality as fundamental disciplines and that they have the institutional support to carry it out. We recommend that the Research Councils, particularly BBSRC and MRC, demonstrate that they are co-operating to ensure that good quality research in SES and SEM does not fall between the two councils.**

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113 Q 22, Q 45, QQ 116–118, Appendix 4.

114 RCP.

115 Q 22.

116 RCUK.

117 *Ibid.*

118 *Ibid.*

119 *Ibid.*

120 RCP, MOD, Professor McConnell, The Physiological Society.

121 Professor McConnell.

122 The Physiological Society.

Absence of co-operation and co-ordination

50. We heard significant concerns about the absence of co-ordination and limited co-operation in the fields of SES and SEM. Professor Jones, Professor McConnell, MOD, Professor Mullineaux, RCP and The Physiological Society were critical of the absence of co-ordination.[123] Professor McConnell described SES as "rudderless".[124] The Physiological Society said that there was a lack of incentives for clinicians and researchers to work together,[125] and the lack of co-operation was confirmed by RCP, MOD and Professor Jones.[126] The Physiological Society concluded that "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".[127] The need for co-ordination and co-operation was a key theme in evidence. As the NIHR promotes research of benefit to patients and the public, and is recognised for its collaborative approach, they are well placed to promote this co-ordination and co-operation.[128] **Given the importance of co-ordination and co-operation to further this field, we recommend that the NCSEM lead the development of a National Sports and Exercise Science and Medicine strategy. Such a strategy would seek to engage researchers and clinicians (both from within and outside the Centre) to identify key research needs, improve the quality of research, promote collaboration and co-ordinate research in SES and SEM over the next five years. The Centre should consider the work of international counterparts, to learn from their experiences.**

51. **Furthermore, the expertise of MRC, BBSRC, NIHR, UK Sport, charities, researchers and clinicians in these fields must be shared to facilitate cross-fertilisation of ideas, and to ensure that the lessons of good science applied to elite and non-elite athletes are translated into public health benefits. We recommend that the NIHR provide a lead to this work.**

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123 Professor Jones, Professor McConnell, MOD, Professor Mullineaux, RCP, The Physiological Society.

124 Professor McConnell.

125 The Physiological Society.

126 RCP, MOD, Professor Jones.

127 The Physiological Society.

128 http://www.nihr.ac.uk/about/Pages/default_old.aspx

CHAPTER 4: FINDINGS AND RECOMMENDATIONS

52. During the course of this short inquiry we were presented with little evidence to suggest that the enhancement of the performance of elite athletes is generally based on strong biomedical science. Given the difficulties associated with conducting research with elite athletes, it is important to develop a two-way flow between, on the one hand, observations on elite athletes and, on the other hand, rigorous research on non-elite athletes and the wider public (paragraph 20).

53. The evidence we received has led us to the view that the latest advances in relevant areas of biomedical research are not being consistently applied to improving the performance of elite athletes. Robust methodologies must be applied to sport and exercise medicine (SEM) and sport and exercise science (SES) for them to have maximum effect, and to enable a two-way flow of research between the fundamental and applied disciplines (paragraph 22).

54. We recommend that the Department for Culture, Media and Sport (DCMS) and UK Sport take steps to ensure that the biomedical science UK Sport applies to improving the performance of elite athletes is of the highest quality and meets international peer-review standards that would be applicable in other areas of science (paragraph 23). (**Recommendation 1**)

55. We recommend that UK Sport should, as a matter of principle, undertake to share its research findings more widely, especially where the research is publicly funded (paragraph 24). (**Recommendation 2**)

56. There seems to be sufficient evidence to demonstrate a causal link between physical activity and health benefits for a very wide range of diseases. However, the reasons for this link are not well understood. Research to understand these underpinning mechanisms could be of benefit to elite athletes, non-elite athletes and the wider public (paragraph 26).

57. Where there is a good scientific basis, lessons could be learnt from the study of elite and non-elite athletes that have relevance to the wider public. This "trickle down" of research from athletes to public health benefits will be even more valuable where underpinning mechanisms are better understood (paragraph 30).

58. Given the estimated costs of inactivity (see paragraph 3 above), and the potential benefits of the use of exercise as a preventative measure and treatment for chronic diseases, we recommend that the National Institute for Health Research (NIHR) and other research funders should stimulate research to translate findings of sport and exercise science and medicine to public health benefits (paragraph 39). (**Recommendation 3**)

59. We recommend that the National Health Service (NHS), medical schools, the General Medical Council and relevant professional bodies ensure that appropriate training, both at undergraduate level and in continuing professional development opportunities, is available for health professionals to support the prescription of exercise as a preventative measure and treatment, where science supports this. We invite the NHS to consider adding physical activity to the Quality and Outcomes Framework (paragraph 42). (**Recommendation 4**)

60. We recommend that the National Institute for Health and Clinical Excellence (NICE) assess the quality of research to support the prescription

of specific exercises in the management of chronic diseases and, where the evidence supports it, update their guidelines to reflect these findings (paragraph 43). (**Recommendation 5**)

61. We recommend that the NHS and NICE evaluate the most effective mechanism for assuring the quality of service delivered by exercise professionals in exercise referral schemes (paragraph 44). (**Recommendation 6**)

62. We find it remarkable that DCMS is not concerned with the health benefits of sport (as a form of physical activity). We recommend that the Government take a strong, joined-up approach to promoting the health benefits of exercise and physical activity, and that DCMS play an active part in this. We also recommend that the Government look to international models for improving the quality and application of sport science (paragraph 47). (**Recommendation 7**)

63. Given the level of seed investment made, and the importance of this research, the proposed strategy is unsatisfactory. We recommend that the Department of Health (DH) clarifies the intended role of the National Centre for Sport and Exercise Medicine (NCSEM) and outlines how it will ensure that the work of the Centre will be sustainable (paragraph 48). (**Recommendation 8**)

64. The NCSEM, sports scientists and sport medical professionals must demonstrate that they can undertake research of the same quality as fundamental disciplines and that they have the institutional support to carry it out. We recommend that the Research Councils, particularly Biotechnology and Biological Sciences Research Council (BBSRC) and Medical Research Council (MRC), demonstrate that they are co-operating to ensure that good quality research in SES and SEM does not fall between the two councils (paragraph 49). (**Recommendation 9**)

65. Given the importance of co-ordination and co-operation to further this field, we recommend that the NCSEM lead the development of a National Sports and Exercise Science and Medicine strategy. Such a strategy would seek to engage researchers and clinicians (both from within and outside the Centre) to identify key research needs, improve the quality of research, promote collaboration and co-ordinate research in SES and SEM over the next five years. The Centre should consider the work of international counterparts, to learn from their experiences (paragraph 50). (**Recommendation 10**)

66. Furthermore, the expertise of MRC, BBSRC, NIHR, UK Sport, charities, researchers and clinicians in these fields must be shared to facilitate cross-fertilisation of ideas, and to ensure that the lessons of good science applied to elite and non-elite athletes are translated into public health benefits. We recommend that the NIHR provide a lead to this work (paragraph 51). (**Recommendation 11**)

APPENDIX 1: MEMBERS AND DECLARATIONS OF INTERESTS

Members:

Lord Broers
Lord Cunningham of Felling
Lord Dixon-Smith
Baroness Hilton of Eggardon
Lord Krebs (Chairman)
Lord O'Neill of Clackmannan
Lord Patel
Baroness Perry of Southwark
Lord Rees of Ludlow
Earl of Selborne
Baroness Sharp of Guildford
Lord Wade of Chorlton
Lord Willis of Knaresborough
Lord Winston

Declared Interests

Lord Broers
None

Lord Cunningham of Felling
None

Lord Dixon-Smith
None

Baroness Hilton of Eggardon
None

Lord Krebs
None

Lord O'Neill of Clackmannan
None

Lord Patel
None

Baroness Perry of Southwark
None

Lord Rees of Ludlow
Master, Trinity College, University of Cambridge

Earl of Selborne
None

Baroness Sharp of Guildford
None

Lord Wade of Chorlton
None

Lord Willis of Knaresborough
None

Lord Winston
Chancellor, Sheffield Hallam University
Council Member, University of Surrey
FMedSci, FREng

A full list of Members' interests can be found in the Register of Lords Interests: http://www.publications.parliament.uk/pa/ld/ldreg.htm

Professor Ian A Macdonald, Specialist Adviser

Member of the Scientific Advisory Committee on Nutrition (SACN)
Chair of the SACN Working Group on Carbohydrates
Member of the High Level Steering Group of the Food Network (part of the DH Responsibility Deal)
Member of the Obesity Review Group (a DH Ministerial level committee)
University of Nottingham Representative on the Steering Group of the National Centre for Sport and Exercise Medicine-East Midlands Consortium
Member of the joint Birmingham/Nottingham Medical Research Council/Arthritis Research UK Centre for Musculoskeletal Ageing Research
Member of the Physiological Society
Chair of the QinetiQ Research Ethics Committee (a defence research contractor)
Member of the Medical Advisory Board of LighterLife (an obesity diet and lifestyle company)
Member and former President of the Nutrition Society
Previously member of the Mars Europe Nutrition Advisory Board (currently suspended due to Chairing of SACN Carbohydrates Working Group)
Previously Member of Coca Cola Europe's Advisory Board and Coca Cola Atlanta's International Public Policy Advisory Board (currently suspended due to Chairing of SACN Carbohydrates Working Group)

APPENDIX 2: LIST OF WITNESSES

Evidence is published online at www.parliament.uk/hlscience and available for inspection at the Parliamentary Archives (020 7219 5314).

Evidence received by the Committee is listed below in chronological order of oral evidence session and in alphabetical order. Those witnesses marked with * gave both oral evidence and written evidence. Those marked with ** gave oral evidence and did not submit any written evidence. All other witnesses submitted written evidence only.

Oral evidence in chronological order

**	QQ 1–25	Professor Sir Steve Bloom, Head of Division for Diabetes, Endocrinology and Metabolism, Chair of the Academic Section of Investigative Medicine at Imperial College London and Chief of Service for Pathology at Imperial College Healthcare NHS Trust
**		Professor Tim Cable, Director of the School of Sport and Exercise Sciences and Professional of Exercise Physiology, Liverpool John Moores University
*		Colonel John Etherington, Vice President, Faculty of Sport and Exercise Medicine (UK), Director Defence of Rehabilitation and Consultant in Rheumatology and Rehabilitation at the Defence Medical Rehabilitation Centre, Headley Court
*		Professor Hugh Montgomery, Professor of Intensive Care Medicine, University College London (UCL) and Director, UCL Institute for Human Health and Performance
*	QQ 26–68	Mr David Brooker, Director, Legacy, Department for Culture, Media and Sport (DCMS)
*		Professor Dame Sally Davies, Chief Medical Officer (England) and Chief Scientific Adviser, Department of Health
**		Mr Mike Farrar, Government physical activity champion and Chief Executive of the NHS Confederation
**		Professor Mike Kelly, Director, Public Health Excellence Centre, National Institute for Health and Clinical Excellence (NICE)
*	QQ 69–103	Liz Nicholl, Chief Executive, UK Sport
**		Professor David Patterson, Chairman, Institute of Sports and Exercise Medicine
*		Professor Alan Silman, Medical Director, Arthritis Research UK
*		Professor Nick Wareham, Director of the Medical Research Council Epidemiology Unit
*	QQ 104–128	Anne Milton MP, Parliamentary Under-Secretary of State (Minister for Public Health), Department of Health

* QQ 129–160 Hugh Robertson MP, Parliamentary Under-Secretary of State (Minister for Sport and the Olympics), Department for Culture, Media and Sport (DCMS)

Alphabetical list of all witnesses

* Arthritis Research UK

Professor Greg Atkinson, Teesside University

British Association for Applied Nutrition and Nutritional Therapy (BANT)

British Association of Sport and Exercise Science (BASES)

* Department for Culture, Media and Sport (DCMS)

* Department of Health (DH)

* Colonel John Etherington, Faculty of Sport and Exercise Medicine

Intelligent Health

Professor David Jones, Manchester Metropolitan University

Professor Alison McConnell, Brunel University

Ministry of Defence (MOD)

* Professor Hugh Montgomery, University College London (UCL)

Professor David Mullineaux, University of Lincoln

The Physiological Society

Register of Exercise Professionals (REPs)

Research Councils UK (RCUK)

Royal College of Physicians (RCP)

Sport and Exercise Nutrition Register (SENr)

Sport and Recreation Alliance

Sport England

* UK Sport

University of Central Lancashire, Institute of Coaching and Performance

Professor Jose Viña, University of Valencia

Professor Gerta Vrbova, University College London (UCL)

Wellcome Trust

APPENDIX 3: CALL FOR EVIDENCE

22 May 2012

The House of Lords Science and Technology Committee, chaired by Lord Krebs, is conducting an inquiry into Sports and exercise science and medicine: building on the Olympic legacy to improve the nation's health. The Committee is writing to seek evidence.

Written evidence is sought by Wednesday, 6 June 2012. Public hearings will be held in June. The Committee aims to report to the House, with recommendations, in July. The report will receive a response from the Government, and may be debated in the House.

The Committee seeks evidence on any aspect of this topic, and particularly on the following questions:

Sports and exercise science research

- 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)? How robust is the application of science in this area? For example, is it possible to conduct research within a training environment?
- How is this research relevant to improving the health of the wider public?
- 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?
- How is sports and exercise science research co-ordinated? Who sets the research agenda? Are health professionals involved in setting the research agenda for sport science and vice versa?

Translation of research

- 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?
- What medical treatments and public health interventions involving sport or exercise currently exist?
- 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?
- Are policies on sport, physical activity and health adequately integrated? What, if any, are the barriers to integration? How can the sport and health agendas in Government be better linked to leave an Olympic legacy to improve the nation's health?

APPENDIX 4: SEMINAR HELD AT THE HOUSE OF LORDS

5 March 2012

Members of the Committee present were: Lord Broers, Lord Crickhowell, Baroness Hilton of Eggardon, Lord Krebs (Chairman), Lord Patel, Baroness Perry of Southwark, Lord Rees of Ludlow, Earl of Selborne, Lord Wade of Chorlton, Lord Warner and Lord Winston. In attendance were Chris Atkinson (Clerk) and Rachel Newton (Policy Analyst).

Presentation heard from Dr Scott Drawer, Head of Research and Innovation, UK Sport

Dr Drawer outlined the key organisations within the high performance sport science sector and the regulatory system. He gave details of the funding, targets and objectives of the UK high performance sport sector, specifically focusing on UK Sport. Dr Drawer explained that responsibility for rules and regulation lay with several bodies, not a central organisation, and that the primary regulatory requirement was accreditation for individuals in certain professions. He gave numbers of athletes funded by grants. He suggested that professional athletes represent the pinnacle of human functioning capability and that sports provide a unique insight into the maximum capability of humans. He considered the professional sports area to be an interesting platform for understanding health, wellness and ageing. Dr Drawer offered specific examples of studies, trials and innovations in the field including cold water immersion for recovery and aerodynamic positioning work with cyclists and wheelchair athletes. He highlighted how high performance sports can inform other disciplines. Dr Drawer argued that the majority of investment for high performance sport science and medicine research (as opposed to service provision with is funded by Government and National Lottery) often relies upon the good will of the academic and industrial sectors. Streams of work in sport science include equipment, coaching tools, training science and performance medicine. He suggested that the field is quite "young" when compared to other scientific disciplines internationally. He identified future areas for focus as consistent investment, and academic and industry partnership.

Discussion

- The links between the high performance sport science sector, the musical conservatoires and endocrine researchers with regard to the psychology and physiology of performance were discussed. It was explained that informal links existed with endocrine researchers, through academic groups, but not with musical conservatoires.
- The robustness of the evidence base, primarily in terms of scientific methodology, for sport science studies was discussed. The specific example of enhanced recovery from muscle stress was considered. It was suggested that there was some variation across the literature, and that high performance research applications can feed into mainstream research areas such as cardiology and physiology.
- The voluntary regulation of certain disciplines was discussed. It was suggested that some disciplines, such as medicine and psychology, were better regulated than others.

- Long-term surveillance and experimentation were then discussed. The specific examples of damage from boxing and running were considered. It was explained that the collection of this type of data was ongoing.
- Encouraging sports in schools was discussed, including targets set by government. Sport England are responsible for this area and have recently launched a new youth and community sport strategy.
- The application of high performance research to wider people groups was discussed. It was explained that one of the aims of the 2012 Olympic Games legacy is that it should have applications to the wider public in terms of disease prevention and health.
- The impact of nature and nurture on sporting prowess was discussed. It was suggested that perhaps it was a mix of both. Recent neuroscience studies of musicians were considered. Studies about training capability were also considered.

Presentation from Dr David James, Senior Sports Engineer, Centre for Sports Engineering Research, Sheffield Hallam University

Dr James presented information about the global sports industry, and figures about the economic contribution of sports clothing and equipment to the UK's economy. He outlined the history of sports engineering. He suggested that the UK leads the world in this research. Dr James offered specific examples of innovations in the field. For example, he talked about technology-based coaching tools. He explained the concept of "technology doping". He concluded by discussing public engagement efforts. He suggested that performance enhancement principles could be explored, and that the commercial base could be developed.

Discussion

- The sports clothing market was discussed.
- The use of research findings for commercial purposes was considered. Issues surrounding protection of intellectual property rights were discussed. It was suggested that the sector was judged by traditional research outputs and charged relatively high fees for commercial activities. It was further suggested that the field could develop spin-off opportunities more. The benefits of enterprise spin-off offices were discussed.
- The motivation of sports scientists and engineers was discussed.

National Centre for Sport and Exercise Medicine; Transforming the nation's health with world leading sport and exercise medicine

Professor Myra Nimmo, Dean of the School of Sport, Exercise and Health Sciences, Loughborough University, showed a video detailing the work of the East Midlands Consortium of the National Centre for Sport and Exercise Medicine. The centre is being led by Loughborough in partnership with Nottingham University Hospitals NHS Trust, University of Nottingham, Nottinghamshire Healthcare NHS Trust, University Hospitals of Leicester NHS Trust and the University of Leicester. The video included information on the centre's aims, facilities and examples of its research.

[discussion of the video was taken together with discussion of the final presentation]

Presentation from Professor Fares Haddad, Director of the Institute of Sport, Exercise and Health, University College London Hospital

Professor Haddad explained that sports and exercise medicine (SEM) applies the data from high-level performance research to the population at large, integrates health and exercise studies, and informs disease research. He expressed concern about funding and explained that there is no research grant body which focuses on exercise and health. Professor Haddad outlined training opportunities in SEM. He discussed the potential health legacy of the Olympics. Professor Haddad presented studies exploring the economic costs of illnesses relating to physical inactivity. He explained the benefits of exercise to health and wellbeing. He outlined the role of the University College Hospital/University College London Institute of Sport, Exercise and Health in "bridging the gap from elite SEM services to NHS [National Health Service] services and public health". He offered examples of the centre's research, such as the impact of altitude on performance. Professor Haddad argued that the London 2012 Olympics presented opportunities for improving elite athlete and amateur care, optimising the translation of science into clinical delivery, and supporting the exercise medicine agenda for wellness, disease prevention and disease management. He identified areas for improvement as specific undergraduate SEM training for medical students, funding for the whole area, commissioning exercise as a treatment, the impact of exercise public health campaigns, and improving activity levels and health.

Discussion

- The application of sports medicine to non-elite athletes was discussed.
- The speciality of joint replacement was considered. It was argued that drive and motivation explain the difference between the response to injury of elite athletes and others.
- The legacy of SEM following the Olympics was considered. The translation of SEM to wider public health benefits was discussed.
- Strategies and efforts to encourage children to exercise were then discussed.
- The health benefits of exercise were considered.

APPENDIX 5: SEMINAR HELD AT THE HOUSE OF LORDS

29 May 2012

Members of the Committee present were: Lord Dixon-Smith, Baroness Hilton of Eggardon, Lord Krebs (Chairman), Lord O'Neill of Clackmannan, Lord Rees of Ludlow, Earl of Selborne, Baroness Sharp of Guildford, Lord Wade of Chorlton and Lord Winston. In attendance were Chris Atkinson (Clerk), Professor Ian Macdonald (Specialist Adviser) and Rachel Newton (Policy Analyst).

Presentation heard from Professor Myra Nimmo, Dean of the School of Sport, Exercise and Health Sciences, Loughborough University

Professor Nimmo introduced the field of sport and exercise science. Sports scientists apply science to the contexts of sport and exercise. She presented statistics about the exit routes of sport science undergraduate students. According to UCAS, there are approximately 114 sport science degree courses in the UK, although the make-up of the courses varies significantly. In the 2008 Research Assessment Exercise, 24 of the 40 institutions which offered "sport studies" had 10% of their papers awarded the class 'world leading' in scientific rigour and originality. There was no specific research council to support sport science research, academics applied to the relevant research council as other academics.

One example of ongoing research was the ESPRIT (Elite Sport Performance Research in Training) programme at Imperial College London. Sensors observed elite athletes, and the technology being developed would hopefully have a crossover benefit when applied to household and health environments.

UK Sport and BBSRC held an event considering how researchers could engage with their research agenda, and as a consequence they launched a joint call for research proposals. Only two proposals were funded, and Professor Nimmo argued that their focus on elite sport was "stripped out" because of an inability to control sufficiently and that this represented a missed unique opportunity to study the extreme of the phenotype.

Professor Nimmo explained that it was difficult to develop research purely in sport science of the elite performer, due to the inability to control these elite athletes in the traditional sense. As a result, much of the research was undertaken using QR (Quality-related Research) funding and industry funding. She underlined the quality of students attracted to SES, citing entry requirements and an estimated 85% employment rate at the end of courses at Loughborough University. Another measure of the quality of SES was that results are published in peer-reviewed journals.

She presented examples of work at Loughborough University which demonstrated how sport science informs health. One example was research to attenuate the risk of infection at the Olympic Village, exercise boosts the immune system however at higher intensity they have an increased risk of upper respiratory tract infection.

Another group vulnerable to immunosuppression was those with renal disease and patients receiving dialysis treatment. This was presented as an example of the knowledge gained in sport science being applied to other groups . Loughborough University worked with University Hospitals Leicester to assist these bed-ridden patients with low intensity exercise in order to boost their immune system. Renal failure patients become acidotic, which could be analogous to an elite sprinter, so they translated earlier studies on athletes which involved giving bicarbonate to elite

athletes before high intensity training (to increase time to fatigue) to these renal failure patients, and found that it helped the patients become more mobile.

Another example was the application of the technique of intermittent high intensity training (which is used to improve the performance of athletes) to overweight and obese individuals. The non-athlete group undertook similarly strenuous intensity training (as a percentage of their maximum) and as a result of six sessions over two weeks they had improved glucose control, fat loss and a reduction in the level of inflammatory proteins, which accompany many chronic diseases. She explained that the underpinning mechanisms to explain this were being explored. Through the NIHR Leicester-Loughborough Diet, Lifestyle and Physical Activity Biomedical Research Unit they are exploring this response with a mechanistic study.

Professor Nimmo then introduced laboratory research with synthetic tissue cultures of muscles, being stretched to explore the growth and characteristics of muscle tissue being "exercised"; a "gym in a box". She said this allowed science to inform sport without biopsies from elite athletes or animal studies. She suggested that the possibilities of simulating the effects of ageing and diabetes on muscles could also be explored using this model, although this work was still at the pre-clinical stage.

Professor Nimmo presented epidemiological studies about the determinants of disease, physical activity and nutritional patterns in young people. She described work to gather information from different ethnic groups to understand the determinants of chronic diseases.

Finally, Professor Nimmo explained that not everybody benefits from exercise, in fact some respond negatively in terms of insulin response to exercise. She said that, as the pharmaceutical industry is working towards a personalised medicine agenda, the same needs to apply to exercise as medicine.

She concluded that work in SES is underpinned by the most rigorous science, as one would expect of any higher education establishment.

Short discussion considering:

- The susceptibility of elite athletes to infection. The design of athletes' facilities at the Olympic village was informed by this research. UK Sport document the illness rate of elite athletes and worked with the British Olympic Association to reduce the risk of illness, which included both environmental design of the Olympic Village and building the immunity of elite athletes.
- A clarification that much of the research presented had been small-case, laboratory studies. The preliminary observations from these laboratory studies, and from case studies, were being worked up into randomised controlled trials with larger sample sizes.
- The lack of evidence on how exercise affects asthma.
- Sports and exercise graduates. Most secure jobs in the sports and exercise field and some go on to complete fast-track physiotherapy and dietetic courses.
- The risks of sedentary behaviour.

Presentation heard from Sonia McGeorge, Director of the British Heart Foundation National Centre for Physical Activity and Health

Ms McGeorge introduced the process for producing the CMOs' Physical Activity Guidelines and the evidence base to support them. She first presented the literature survey conducted in the United States to support their equivalent guidelines which found that physically active people have higher levels of health, and a lower profile for medical conditions and chronic disease than those who are inactive. This survey considered clinical and epidemiological surveys. They found clear evidence of health benefits from being physically active, for all age groups. The recommendations made were based on a range of evidence from randomised controlled trials to case controlled studies, and from small to large sample sizes; but recommendations were made where there was consistent evidence across them all. The UK drew heavily upon this work when developing their guidelines.

She described the growth of research in this area since the 1960s. The World Health Organisation (WHO) have found that moderate intensity physical activity helps prevent and manage over 20 chronic conditions. There are also additional health benefits such as improved quality of life and psychological wellbeing. At a population level, she suggested that tackling those who were least active would have the greatest effect. In relation to studies across the whole lifetime, it has been found that the risk of disease was 30% less for the active when compared to the least active. She presented examples such as an inverse relationship between physical activity and the risks of cardiovascular disease, coronary heart disease and stroke. She also presented research about the benefits of physical activity for colon and breast cancer. Physical activity can also reduce the risk of falls in the elderly population.

Ms McGeorge also presented the negative effects of inactivity, such as premature mortality, reduced growth, and increase risk of chronic disease. She emphasised that there were also short term benefits from physical activity. Much of the existing evidence is for adults, but some research for young people exists. The evidence for under-fives is much less strong and not as developed, but the UK expert group who helped produce the CMO Physical Activity Guidelines found sufficient evidence for some specific guidelines.

Physical activity plays a key role in the management and treatment of chronic conditions too: these had been considered in a series of Cochrane systematic reviews.

Ms McGeorge discussed the costs of inactivity. The WHO consider physical inactivity to be the fourth risk factor responsible for global deaths—6% deaths globally. Work has been done to research the economic costs too. It is estimated that it costs the NHS £0.9 billion a year, and that lost productivity costs UK Plc approximately £5.5 billion. The costs of premature death of work-aged people is estimated at £1 billion, and the physically inactive spend 38% more days in hospital than the active. Sonia described several global conferences and meetings which identified the risks of physical activity as modifiable.

The revised UK Physical Activity Guidelines were published in July 2011. The revision process started in 2009, when it was decided that the evidence base had developed sufficiently to justify a review of the evidence and to consider the implications for the guidelines. Furthermore, despite strong evidence of the benefits of physical activity, high levels of inactivity across UK persisted. There was also emerging evidence for under-fives and the elderly. Finally, there was inconsistency in guidelines across UK. The guidelines produced are evidence-

based summary statements on the benefits of physical activity. They represent a consensus of experts on evidence and recommendations for a population based approach to physical activity. The process to develop was collaborative, and was led by the British Heart Foundation and DH. Expert groups contained international experts with experience of developing guidelines in other countries. The consultation process led to the development of a technical report. Then guidelines were produced which had to be workable and easily understood.

First roundtable discussion considering:

- Evidence about chronic disease prevention. This was primarily epidemiological. Evidence for the use of exercise in the treatment of specific conditions varies—some was supported by randomised controlled studies. However, it was argued that, due to funding limitations much of this work was not well followed-up, and generally the transition to community based self-management was poor.
- The reasons underpinning the reduction of risk of coronary heart disease by physical activity: physical activity reduces blood pressure, improves the blood lipid profile and improves insulin sensitivity.
- Early stage research about muscle activity reducing the production of inflammatory cytokines, which has a positive influence on plaque formation in coronary arteries, and reduces inflammation in adipose tissue.
- Whether the overall health benefits of exercise outweighed the risks. There are risks associated with vigorous exercise and over-exercise.
- The difficulties of accounting for environmental stress factors in epidemiological studies.
- The elevated risk of disease in sedentary populations. For example, research suggests that the risk of myocardial infarction increased 2.4x in the hour after intense exercise among those who report reported to undertake regular, intense physical exertion, compared to a 107x increase in risk for those who rarely exerted themselves.
- The underpinning mechanisms explaining findings, which are not well understood. It was suggested that funding had been primarily for epidemiological studies. Recently, charities such as the British Heart Foundation, Macmillan and Arthritis Research UK had provided some funding for this type of work. It was suggested that currently we can explain 65% of the benefits, but 35% are unexplained by conventional science.
- The types of work undertaken and modern lifestyle, which mean that much of the population are spending increasing amounts of time in a sedentary state.
- The dangers of health inequalities, such as having the time and access to facilities to exercise. It was suggested that there were policy implications for health, transport, and school playing fields, for example.
- Evidence that even if one meets the recommended levels of physical activity, health risks still rise if significant portions of time are spent sedentary.

- The absence of longitudinal data regarding the life expectancy of elite athletes. However, the risks of overuse of joints have been explored and those working with elite athletes try to prevent that abuse and monitor activities undertaken to try and prevent long term health problems.
- The relevance of principles of elite training to non-elite athletes, in that baseline fitness is incrementally enhanced.
- Ongoing research into the economic benefits of regular exercise. It is thought that exercise boosts productivity and saves money for healthcare.
- Research suggesting that the life expectancy of elite American football players is reduced.
- The side effects of exercise.
- Lessons from injury prevention with elite athletes informing school sports. For example, warm-ups to reduce ham string injury have been shared. The Federation of Association Football (FIFA) have a programme in schools to reduce knee injury through exercises.
- Avoiding injury not forming part of the physical activity guidelines. The dissemination of these guidelines, it was argued, was not that wide to public or professional groups and consequently there was not the desired level of awareness among health professionals.
- The differences between exercise and fitness.
- One example of the health benefits of exercise: the use of strength training and balance training to reduce falls.
- Physical activity as an indicator in the Public Health Outcomes Framework. This was measured through the Active People Survey, a self-reporting questionnaire about sporting participation. It was acknowledged that there is a risk of overestimation in this work.
- The NICE guidance on exercise referral schemes which contained a cost effectiveness component. This found that the benefits justified the costs of short interventions.
- The standards and qualifications for exercise professionals. Skills Active and the Register of Exercise Professionals have level one to four qualifications, but these are not compulsory for exercise professionals. There is work at a European level to raise standards in this field.
- Awareness of the physical activity message among health professionals. This was not considered to be effective. For example, in an informal survey, less than 30% of GPs in Northwest England were aware of the latest UK physical activity guidelines. It was suggested that adding physical activity or exercise to the GP Quality and Outcomes framework would encourage GPs to learn more about this area.
- Cultural barriers to exercise. It was suggested that, for many people, exercise was not the social norm, and so physical activity was a public health issue—the question was asked: how do you make society live an active life? The benefits of dance as a socially acceptable form of exercise were discussed.

- The paucity of randomised controlled trials undertaken with elite athletes. However, it was thought that they are providing good case studies and research which can be translated into benefits for other groups.
- The addressing of gaps in translational research by the Biomedical Research Units at UCL and Loughborough, and the Centre for Diet and Activity Research (CEDAR). It was suggested that BBSRC, MRC and NIHR pass applications submitted to the wrong organisation to each other, as each has a specific remit: BBSRC and MRC fund more fundamental science, and NIHR fund research for patient benefits.

Presentation heard from Professor Fares Haddad, Director of the Institute of Sport, Exercise and Health, University College London Hospital

Professor Haddad presented about the NHS' provision of exercise treatments. The NCSEM will, through collaboration, support the use of SEM in the NHS and to promote translational research. The Centre will help translate research from elite athletes and from exercise studies to public health benefits. They will help focus on physical activity and health, improved care for sportsmen and women, improving musculoskeletal health, exercise for chronic disease, mental wellbeing and performance.

SEM used to be a special interest of a few medical practitioners, now there is a specialist stream being developed. New jobs are currently being created and consultants are being trained. SEM specialists will provide knowledge and the infrastructure will be developed to allow them to deliver across the NHS. They will explore, for example, exercise as treatment for obesity, diabetes, cancer. They will consider new models for delivering exercise.

Professor Haddad described how elite athletes are different physiologically but can offer principles which can be learnt from. They also have the potential for promoting physical activity by acting as role models. He said the NCSEM want to translate findings from elite athletes to the wider population.

He described the use of exercise to improve, avoid and delay osteoarthritis by reducing muscle wasting. Ultimately this can reduce the need for knee surgery.

He gave a further example of the use of sport science for health: findings from hypoxic training, physiological adaptations when exercise at altitude, are being translated to assist the critically ill to combat muscle wastage.

Roundtable discussion considering:

- The use of exercise to manage osteoarthritis.
- The Physical Activity Guidelines. They are not specific about exercise for specific conditions. It was argued that this kind of treatment plan needs to be individualised and supervised. Furthermore, patients often suffer from multiple conditions which need taking into consideration in the prescription of exercise.
- The goal of the creation of the SEM speciality. They will facilitate education for exercise prescription.
- Prescription of exercise by GPs. It was suggested that GPs do not know what to tell patients and are uncertain as to what exercise is safe. If this kind of advice was issued by NICE it was thought that GPs might be more inclined to prescribe exercise. It was argued that medical

professionals are not consistently trained to prescribed exercise. SEM specialists will be trained, not to deliver these prescriptions each time, but to provide guidance and to develop the research base for it. It was suggested that SEM specialists and the NCSEM could demonstrate the benefits of exercise and provide the expertise to help further the delivery of exercise prescription.

- PARQ (Physical Activity Readiness Questionnaire) Plus. This questionnaire aims to help certain patients self-assess whether they are well enough to exercise.
- The need to embed exercise as treatment in the NHS in the same way as pharmacological interventions.
- Advice notes for physical activities to help specific conditions being developed by a private company.
- The envisaged work of the NCSEM to speed up the translation of SEM research to NHS services.
- The lack of ongoing funding for the NCSEM. DH provided a capital grant to create facilities. Sponsorship was being explored. The Centre will bring research and clinical work together. Sheffield CCGs are already commissioning the SEM services. It was suggested that there is a need to create appetite in commissioning exercise. One way suggested was to create knowledge in the marketplace.
- A previous NICE evaluation which found limited effectiveness amongst the 300 UK exercise referral schemes that exist. It was suggested that the structure for delivering exercise referral needs to be reconsidered.
- An example of barriers to translation: a device for training respiratory muscles, to manage chronic obstructive pulmonary disease. It was suggested that if we understood the underpinning mechanism this treatment could be better applied and interventions modified.
- Animal models.
- Lack of integrated policy between health, physical activity, and other areas such as transport.
- The success of a recent Macmillan campaign regarding the importance of exercise for cancer patients.
- The value of exercise professionals forming part of multidisciplinary teams, in the same way that physiotherapists can do.
- The lack of training for GPs. Developments such as teaching of sport science in special subject modules for undergraduate medical students and intercalated degrees in sport science were discussed. It was suggested that there might not be sufficient expertise within medical schools to deliver this training, but it was also suggested that SEM specialists could help with this provision.
- The reduction in physical activity provision, such as sports areas, by local councils.
- The barrier of health and safety to the delivery of strength training within the NHS.

- The need to raise public awareness of benefits of physical activity, giving the public confidence and skills to do something about it, and addressing the cultural environment to make that acceptable. This would need support from the public, professionals, policy makers (both national and local) and the media.
- It was suggested that the Research Councils and Higher Education funding councils are seeking to address the paucity of integrated physiology and whole systems approach research.
- The similar difficulties in promoting exercise and healthy eating.
- The need to explore underlying mechanisms so that interventions can be optimised and to replicate benefits through other means for those who cannot or will not exercise. It was suggested that this work 'falls between the cracks' in terms of funding.
- Current NICE guidelines for illness. Over 30 of NICE's current guidelines say exercise has a role to play in treatment of specific conditions, but their advice is usually general, top-line comments. They do not discuss how or what specific type of exercise would be appropriate.
- The importance of coaching. It was suggested that this is done well by teams supporting elite athletes and that the treatment of the wider public would benefit from this type of work.
- The benefits of physical activity for businesses. These include better productivity from employees and increased speed in recovery from illness.
- The mental health benefits from exercise being shown in the evidence base. For example, the evidence suggests that exercise can help reduce anxiety and depression.
- The need to change the culture of research within institutions to promote the development of resources such as information for health professionals, for example, as well as publication in high-impact journals.
- The work of UK Sport and Sport England. UK Sport conduct a survey with their clients each year about their satisfaction with their service. Sport England conduct the Active People Survey. DCMS do not have the scientific expertise to quality assure the use of science by its arm's length bodies.
- How studying elite athletes can provide useful information to inform the treatment of the critically ill. For example, by characterising the mechanisms by which heart function improves with exercise in elite athletes and the military, we can tell how heart function is impaired in people with diabetes or with high blood pressure. Understanding the impact of training on metabolic efficiency helps understand inefficiency in cancer. By understanding the mechanism of growth in muscles by exercise, this can help combat muscle wasting in intensive care patients.
- The value of SEM and SES. It was argued that they are not trivial, marginal, or elitist—they are of relevance to patients of every age, stage and disease.

APPENDIX 6: ABBREVIATIONS AND ACRONYMS

AIS	Australian Institute of Sport
BASES	British Association of Sport and Exercise Sciences
BBSRC	Biotechnology and Biological Sciences Research Council
CEDAR	Centre for Diet and Activity Research
CMO	Chief Medical Officer
DCMS	Department for Culture, Media and Sport
DH	Department of Health
EIS	English Institute of Sport
ESPRIT	Elite Sport Performance Research in Training
GP	General Practitioner
MOD	Ministry of Defence
MRC	Medical Research Council
NCSEM	National Centre for Sports and Exercise Medicine
NHS	National Health Services
NICE	National Institute for Health and Clinical Excellence
NIHR	National Institute for Health Research
QOF	Quality and Outcomes Framework
QR	Quality-related Research
RCP	The Royal College of Physicians
REP	Register of Exercise Professionals
SEM	Sport and exercise medicine
SES	Sport and exercise science
UCL	University College London
WHO	World Health Organisation

APPENDIX 7: RECENT REPORTS FROM THE HOUSE OF LORDS SCIENCE AND TECHNOLOGY COMMITTEE

Session 2006–07

1st Report Ageing: Scientific Aspects—Second Follow-up
2nd Report Water Management: Follow-up
3rd Report Annual Report for 2006
4th Report Radioactive Waste Management: an Update
5th Report Personal Internet Security
6th Report Allergy
7th Report Science Teaching in Schools: Follow-up
8th Report Science and Heritage: an Update

Session 2007–08

1st Report Air Travel and Health: an Update
2nd Report Radioactive Waste Management Update: Government Response
3rd Report Air Travel and Health Update: Government Response
4th Report Personal Internet Security: Follow-up
5th Report Systematics and Taxonomy: Follow-up
6th Report Waste Reduction
7th Report Waste Reduction: Government Response

Session 2008–09

1st Report Systematics and Taxonomy Follow-up: Government Response
2nd Report Genomic Medicine
3rd Report Pandemic Influenza: Follow-up

Session 2009–10

1st Report Nanotechnologies and Food
2nd Report Radioactive Waste Management: a further update
3rd Report Setting priorities for publicly funded research

Session 2010–12

1st Report Public procurement as a tool to stimulate innovation
2nd Report Behaviour Change
3rd Report Nuclear Research and Development Capabilities
4th Report The role and functions of departmental Chief Scientific Advisers
5th Report Science and Heritage: a follow-up