Institution: University of Exeter

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

a. Overview

Sport and Health Sciences (SHS) at Exeter provides a vibrant research-intensive environment for academics and post-graduate researchers (PGRs), organised into two interdisciplinary groups: Bioenergetics and Human Performance (**BHP group**) and Physical Activity and Health Across the Lifespan (**PAHAL group**). The groups include 24.3 FTE with some overlap of staff across both groups, but approximately 16 full-time equivalent (FTE) in BHP (Armstrong, Bailey, Barker, Bowtell, Dixon, Freeman, Fulford, Gates, Jackman, Jones, Krustrup, Mohr, Rees, Stiles Vanhatalo, Vine, Wilkerson, Williams, Wilson) and 8.3 FTE in PAHAL (Armstrong, Barker, Gracia-Marco, Griew, Hillsdon, Metcalf, Pulsford, Stiles, Taylor, Wilkerson, Wilkin, Williams). Together there are 9.4 FTE Early Career Researchers (ECRs), 9.6 mid-career researchers, and 5.3 Professors.

BHP: This group focuses on understanding and enhancing human performance through integrated research in applied physiology, psychology, nutrition and biomechanics. Led by Jones, the group investigates the factors that limit human performance and the efficacy of interventions (exercise, pharmacological, psychological, nutritional and technological) for enhancing performance across a range of human populations. Key research questions within the group include limitations to muscle oxidative metabolism, determinants of fatigue, lower limb injury mechanisms, and cognitive and psychosocial determinants of human performance. Interdisciplinary approaches are common.

PAHAL: This group, led by Taylor, conducts pre-clinical laboratory and fundamental research and epidemiological and intervention studies, involving both adult and paediatric populations. Experimental work explores the acute effects of exercise and sedentary behaviour on a range of measures, including physiological (e.g., using Magnetic Resonance Imaging and Spectroscopy, DEXA scanning, and metabolic biomarkers), psychological (affect and mood, cognitive functioning, substance cravings and cue reactivity - using eye tracking and fMRI bias), and behavioural (e.g., substance use, dietary intake). Translational research considers if, and how, theory-driven interventions impact on behaviour and health, particularly within health care, among children and adults. Epidemiological work explores the relationships between environment, demographics, physical (in)activity and physical and mental health outcomes, across the lifespan.

b. Research strategy

1.1 RAE 2008 revisited: In RAE 2008, the 26 SHS staff submitted (100% return) were aligned within five relatively independent discipline-driven research groups. Between 2001 and 2008, a rapid growth in undergraduate and post-graduate student numbers at Exeter provided a firm financial foundation for fostering a research-intensive environment. Following RAE 2008, the five research groups were reconfigured to our two existing groups to consolidate existing strengths and identify key areas for research growth, facilitate interdisciplinarity, produce high quality outputs, secure greater impact and external funding, and provide a greater alignment with the University Science Strategy. SHS was integrated into a new College of Life and Environmental Sciences (CLES) in 2010, with the disciplines of Biosciences, Geography and Psychology, to emphasise its Science, Technology, Engineering, and Mathematics (STEM) facing research and to facilitate the provision of a consolidated research support infrastructure. SHS has benefitted greatly from the strategic growth in Exeter University's science research, to strengthen its position as an internationally renowned research-intensive University. Our RAE 2008 strategy, with relatively less focus on interdisciplinary research, was revised to reflect this opportunity to develop interdisciplinary research within CLES (e.g., Mood Disorder Centre, Psychology), to work with the Medical School (initially the Peninsula School of Medical and Dentistry, then University of Exeter Medical School – UEMS, from 2012) and other STEM facing disciplines (i.e., College of Engineering, Maths and Physics). Both the BHP and PAHAL groups have taken full advantage of the opportunities to collaborate and build research capacity during this period of institutional growth. Indeed, in terms of research income spent, SHS has experienced a 174% increase from 2007/8 to 2012/13. In particular, income from UK Research Councils has grown from <5% to 30% of total research income spent over the REF period. With this increased investment in our research we have been able to conduct more rigorous and advanced research.

1.2 Research developments since 2008: In the context of emerging opportunities across the University, our strategy has been to achieve a vibrant and sustainable research environment in four specific ways: **(a)** appoint staff with proven capability or clear potential to conduct externally-

funded, high-quality, interdisciplinary research; **(b)** maintain the number and quality of PGRs per staff fte, and support their development; **(c)** support the personal development of all research-related staff from early-career and mid-career academics, to Professors, and technical staff; **(d)** seek to maximise impact at all stages of research.

(a) Staffing and building capacity: The University provides regular opportunities to review the strategic funding priorities of Research Councils and leading UK charities, and funding streams in the European Union. This has guided our strategy to appoint staff to research themes (e.g., biomedical science, human health and performance) that are sustainable and maximise the infrastructure and facilities available. Notable staffing appointments since 2008 included Prof Krustrup with Mohr from Copenhagen, and Jackman (Birmingham) who, with £250k of internal investment, established the platform for extending biochemistry and metabolic research in SHS. Of the 9.4 fte ECRs in the REF submission, Bailey, Barker, Pulsford and Vine completed their PhD at Exeter and went on to become Lecturers. Vanhatalo and Bailey were appointed as ECRs to work with Jones and the BHP group. Vine was appointed to work with Wilson in the BHP group. Barker and Gracia-Marco were appointed to work in the Children's Health and Exercise Research Centre (CHERC). Pulsford, Griew and Metcalf were appointed to work with Hillsdon, Taylor and others in the PAHAL group. Among the mid-career researchers, Fulford and Gates have strengthened the BHP group through their expertise in the non-invasive assessment of tissue metabolic and vascular responses to exercise and other interventions both in health and disease. The unit has also developed significant research strength in the epidemiology of paediatric health and behaviour, with links to the EarlyBird Study (led by Wilkin, with Metcalf as statistician), the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study (Gracia-Marco), the International Children's Accelerometry Database (Griew), and Personal and Environmental Associations with Children's Health (PEACH) study (Hillsdon).

(b) PGR capacity and development: Following RAE2008, we aimed to maintain the number of PGRs per staff fte, enhance the quality of research training and increase exposure to interdisciplinary research to enhance career opportunities. This has been achieved through the following strategic approaches: (a) internally funded research studentships (Graduate Teaching Assistantships; GTAs); (b) recruitment of international PGR students, as part of the broader University's Internationalisation strategy; (c) seeking externally funded studentships with RKT support (e.g., ESRC Case Studentships, MRC studentship); (d) using our MSc programmes to identify strong potential PGRs; (e) partnering with the Business School on a successful £1.5m ESRC Capacity Building Cluster grant (for a Sport, Tourism and Leisure Centre) in 2008-9; and (f) leading on a successful bid with Bristol and Bath for an ESRC interdisciplinary Doctoral Training Centre in 'Health and Well-being.' Greatly enhanced support for PGR development was achieved through the following: (1) ensuring all PGRs have a 1st and 2nd supervisor, and a mentor; (2) careful monitoring of PGR progress through 'my-PGR' online monitoring system which facilitates embedded review processes; (3) ensuring PGR students are enrolled on an MPhil/PhD path and undertake an upgrade process to progress onto the PhD involving 2 independent assessors, and a public presentation; and (4) offering a range of PGR generic and specific development opportunities (via an Effective Researcher Development Programme (http://www.exeter.ac.uk/student-skills-development/). Jackman leads in-house training needs assessment among ECRs and PGRs and arranges specific training and workshops. In a review for our Athena SWAN application, since 2001 76% of female and 86% of male graduating PGRs have entered a career in education and/or research, providing evidence for the success of our career support processes.

(c) Academic development at all levels: There are many support mechanisms in place for researchers at all levels, from ECRs to mid-career and more senior academics, which follow the key principles of the RCUK Concordat. All ECRs work with an Academic Lead to identify annual targets and performance development plans for teaching and research activity, for 5 years within the Professional Development Programme (http://www.exeter.ac.uk/staff/development/pdr/academic/pdp/). More senior academics also have an Academic Lead with whom they discuss targets for research (and teaching and administration) in a collaborative and supportive way. The Discipline's Director of Research and member of the CLES Research Strategy Group (Taylor) raises awareness of opportunities for personal development within and outside the University, grant applications and research collaborations. He also coordinates an internal peer review system for grant proposals, which provides detailed feedback to researchers to support their development.

(d) Maximizing Impact: Since 2008 we have engaged with a wide range of partners with the support of RKT (e.g., through interdisciplinary workshops, 'Bridging the Gap' (BTG) funding, Link Fund, and business vouchers). Funded research has helped to build a vibrant research environment to conduct scientifically rigorous 'proof of concept' and fundamental research with a forward looking vision to translate that work in a way that end users, including policy makers, business, organisations and professionals can use to ensure impact. Indeed, some of the discoveries in physiology and food supplementation we have made to enhance sports performance are now being applied to enhance healthy ageing and to combat disease processes.

1.3 Research strategy to 2019: The 2012 House of Lords Select Committee Report on Science and Technology, 'Sport and Exercise Science and Medicine: Building on the Olympic legacy to improve the nation's health' highlighted the need for strong biomedical science to enhance human performance and extend the research to general and clinical populations. Consistent with this, our strategic approach to developing and conducting interdisciplinary research is designed to result in significant advances in our understanding of how to maximize human performance and contribute to global evidence for the effectiveness of interventions to promote physical and mental health. We intend to capitalize on the significant growth and investment in infrastructure planned for UEMS on the St. Luke's campus by consolidating and expanding our collaborative work with the Medical School. This will involve fundamental investigations into the role of exercise and nutrition on physiological function in health and disease and translational research to promote physical activity for health across the lifespan. Planned future staff appointments will add capacity in these areas.

Making research more sustainable: SHS aims to double research income by 2019 through some of the following supported approaches: (1) submitting more strategic bids to responsive calls, by involving carefully selected collaborators with experience of grant funding, particularly for ECRs; (2) operating an internal peer review system for grant proposals; (3) seeking developmental grants in a staged approach (as per MRC Framework for Complex Interventions) towards submitting larger bids; (4) continued mentoring of early career staff by research group leaders and senior colleagues; (5) investing in infrastructure dedicated to research support and development, described in more detail below; and (6) supporting grant applications led by others, by providing expertise in the use of a range of technologies and methodologies.

The next generation of researchers: Attracting and supporting some of the best PGR students will be a priority. With students completing undergraduate degrees with greater debt than previously, we aim to continue to maximize the employability of our PGRs, through career support, work placements, and partnership funding, thereby providing a financial rationale for undertaking PGR training. We will also be focusing on the recruitment of promising international students, with the support of CLES resources (e. g., travel support for visiting targeted institutions) guided by the University's internationalization strategy and mission to become a global top 100 university.

Developing and retaining staff: In terms of staff development, many support mechanisms are already in place for researchers at all stages of their career. We recognize in SHS the need to specifically support the Athena SWAN charter to work towards gender equality within STEM/M subjects. Each Discipline in CLES is working towards achieving a silver award in 2014. Led by Bowtell, this requires the continued identification and implementation of cultural and structural change to improve the career support, progression, and wellbeing of all staff within the College.

c. People, including:

i. Staffing strategy and staff development

The College and Discipline have worked together to shape a strategic plan for staffing and staff development. A workload model, supported by an assigned Academic Lead, ensures a strategic approach to support staff to achieve research goals and career development identified through the annual Personal Development Review process. The staffing level is based on maintaining an appropriate staff-student ratio for taught undergraduate and post-graduate courses, but also to ensure a balance of junior and senior researchers and critical mass across the research groups.

Early career researchers are supported in a number of ways. For example, Stiles and Wilkerson progressed from Lecturer to Senior Lecturer having been directed to, and supported with, applications for funding from the National Osteoporosis Society and Diabetes UK, respectively. As Lecturers, both were also awarded internally funded GTA students, to develop supervisory skills with a more senior academic, as well as support their own research programme. Currently all ECRs receive £1000 (for Lecturers) or £500 (for Associate Research Fellows) per

annum to develop personal research skills (e.g., new methodological or analytical training). Associate Research Fellows with strong potential to progress to a Lecturing post are identified and supported. For example, Vanhatalo worked closely with Jones in 2009, and RKT funding helped her to remain at Exeter and eventually become a Lecturer. Others (e.g., Bailey, Barker and Vine), after completing their PhD at Exeter, were identified as having excellent potential and were appointed as Associate Teaching Fellows before becoming Lecturers. All newly appointed Lecturers have minimal teaching in the first term and no administrative responsibilities in the first year to provide time to become embedded in the research intensive culture at Exeter. This strategy has been very successful. For example, Gracia-Marco was awarded a EU100k Marie Curie Career Integration Grant and developed collaborations with colleagues interested in bone health research. All new Lecturers (without an equivalent qualification) are supported to undertake the Postgraduate Certificate in Academic Practice leading to Fellowship of the Higher Education Academy.

Mid-career researchers have been supported with outward mobility grants (e.g., Wilson with an ESRC grant to Hong Kong), and strategically given a reduced teaching load to focus on grant applications or producing high quality outputs (e.g., Dixon and Bowtell). Bowtell, Hillsdon and others have been supported in developing collaborations through University interdisciplinary networks such as the Peninsula networks for Obesity Research (PenCORE), and Aging Research (PARC). Mid-career researchers have been encouraged to seek prestigious external appointments (e.g., to journal editorial boards: Bowtell, Rees and Wilson) as part of their career development. Support from the College Strategic Development Fund has also been prioritised for mid-career researchers for specific equipment (e.g., Bowtell for ^{13}C-MRS).

Senior researchers have been supported by strategically developing coherent areas of related research. For example, after Armstrong was appointed as a Deputy Vice Chancellor in 2005, though remaining an active researcher, Barker, Gracia-Marco and Metcalf have been appointed as ECRs to ensure a critical mass in CHERC. Williams was promoted to a Chair in 2012 and leads CHERC. Jones has been supported in developing his research group with the appointment of Bailey and Vanhatalo, and brought in a complementary research group (i.e., Krustrup, Mohr, Bowtell, Jackman). Also, the emergence of the new College structure enabled some of the senior management tasks (e.g., PGR monitoring and Ethical approval systems) to be centralised and automated through advancement in IT systems, thus reducing administrative burden. Similarly, grant application and post-award support is now centralised. Senior researchers have been encouraged to take on leadership positions such as journal chief editorships (e.g., Hillsdon, Jones, and Taylor), and membership of grant review boards (e.g., NICE review panel - Hillsdon; NIHR College Reviewers - Taylor; ESRC College Review panel - Wilson).

At all levels, academics engage with an Academic Lead to set and review annual targets for research, teaching, and administration. A negotiated balance across these roles is based on supporting individuals, while naturally meeting the unit's on-going and strategic aims. Annual Away Days and termly staff meetings provide an open forum for reflection on research strategy. All staff have been engaged in the University's bid for an Athena SWAN Silver Award through focus groups to identify interventions to support equality and diversity in all forms of employment.

Both junior and senior staff access College support for Study Leave, which is strategically awarded to enhance research outputs and activity. Applications for external funds to facilitate career development are also encouraged. For example, Wilson received an ESRC Fellowship, a UK-China Fellowship for Excellence Grant (Department of Business, Innovation and Skills) and a University Outward Mobility Academic Fellowship to develop collaborations with Prof Masters (U of Hong Kong) for 6 months and 1 month in 2010 & 2011, respectively, Jackman spent 1 month with Prof Bangsbo (University of Copenhagen), and Bailey spent 3 months with Prof Hogan (University of California, San Diego) in 2012. A UK Sport secondment allowed Rees to work with Prof Hardy Bangor University), for 4 days per week (2009-2012).

ii. Research students

Building capacity: During the REF cycle, 35.6 PhDs have been awarded in SHS. We have been able to select some very strong PGRs to enhance our research culture, some of whom (Bailey, Barker, Freeman, Stiles, Vine) we have retained initially as Teaching Fellows and then Lecturers. From 2008-2010, we strategically awarded 4-7 GTAs per year, covering tuition fees and a stipend. Since 2011/12, to enhance sustainability, we have re-focused on generating external (matched) funding for PGR studentships. While this strategy has resulted in a slight recent (and, we believe, short-term) dip in PGRs, the absolute number of PGRs remains high and registered full time

equivalent (FTE) PGRs per staff FTE has remained stable over the REF cycle (1.78 in 2008/9 and 1.87 in 2012/13; see table).

	2008/09	2009/10	2010/11	2011/12	2012/13
PGRs	40.1	38.7	36.7	31	31.9
PGRs per FTE	1.78	1.97	2.25	1.83	1.87

In addition to industry-sponsored and international students, some PGR studentships have come from University Translational Medicine Science Strategy funding, and Case PhD awards as part of the ESRC Sport, Tourism and Leisure capacity building centre. Taylor has been Exeter lead for the ESRC funded South-West Doctoral Training Centre for the interdisciplinary Health and Well-being pathway (with Bristol and Bath Universities). As part of this, an MRes in Health and Well-being began in 2011. Exeter was awarded a studentship in 2011, 2012 and 2013, of the two available annually.

PGR supervision and support: To enhance PGR development and prepare students for interdisciplinary research, several students have been co-supervised by staff outside of the UoA, including Janse van Rensburg, Haasova, Elliott, Lambert (by Taylor with Hodgson - Psychology, Warren, White and Greaves - UEMS, respectively), Green (by Rees with Peters - Psychology), Parnell (by Williams with Barr - Geography), Pulsford (by Hillsdon with Kos - UEMS), and Williams (by Williams with Wyatt - UEMS). PGR students and staff are encouraged to attend seminars across the University and health-related South-West research networks (e.g., PenCORE, PARC, Mood Disorders Centre, and other SHS and UEMS seminars). PGRs have also been financially supported to attend training workshops (e.g., European neuro-imaging workshop, Spain; MRC workshop on neuroscience and addiction, London) and helped to win funding to present at conferences (e.g., North American Society for Neuro-imaging Conference, Toronto; Society for the Study of Addiction PhD Studentships Scheme, Oxford). Some PGRs have joined the National Trial Managers network and the UK Society of Behavioural Medicine Student network to support their development. Finally, PGRs attend SHS research seminars delivered by guest speakers (with Physiology Society Support), and MPhil/PhD conversion presentations. In a competitive process, PGRs are funded to attend major international conferences (e.g., ECSS and FEPSAC), and the BASES student conference. All GTAs undertake the Learning and Teaching in H.E. Programme. PGRs engage in the Annual Research poster day and bi-weekly seminar programme, and receive support from the University PGR research enhancement fund.

d. Income, infrastructure and facilities

3.1 Research Income: Since RAE2008 we have significantly increased external funding to build research capacity and the sustainability of high quality research with the potential to have a significant impact on health and well-being and human performance in a variety of contexts. Appointing staff with the potential or proven capacity to attract research funding, supporting them with dedicated time and resources for preparing applications, and facilitating interdisciplinary working has had demonstrable success and we continue to approach this as a major priority in the new HEI funding climate. Total research income spent in SHS has increased from £203k in 2008/9 to £350k, £654k, £514k and £556k in 2009/10, 2010/11, 2011/2 and 2012/3, despite a planned reduction in staff fte from RAE 2008 (28) to the current 24.3. The increases in income were evident for all HESA categories for sources of funding, but especially for funding from Research Councils and UK Central government/local health and hospital authorities, with increases of 30% and 34%, respectively. In terms of income spent per staff fte this has increased from £8K in 2007/8 to almost £23k in 2012/3. Overall, SHS staff have been awarded grants worth £3.1m during the REF cycle.

£1.64m was awarded to researchers in **the BHP group** up to July 2013. This has come from a diverse range of sources including the following: (1) business and commerce, such as, Gatorade/PepsiCo to Jones and Vanhatalo (£457k for examining the effects of ergogenic aids on exercise performance), Cherry Marketing Institute to Bowtell (£30k for exploring effects of cherry polyphenols on age-related anabolic resistance), the International Tennis Federation and Umbro to Dixon (£30k for surfaces and injury prevention); (2) sports governing bodies, such as, the Rugby Football Union (RFU) to Wilson (£20k for match analysis and adapting rugby for juniors), and UK Sport to Rees (£104k for talent identification with the England and Wales Cricket Board (ECB); (3) the Ministry of Defence (MoD) to Dixon (£4.5k + equipment for injury prevention work); (4) Research Council awards such as the ESRC to Wilson (£67k for investigating surgeon's visuo-spatial learning and performance in demanding conditions), the EPSRC to Dixon (£235k for understanding traction for sports shoe and surface combinations), and the Faroese Research

Council to Mohr (£50k for research into exercise training and muscle metabolism); (5) charities, such as RAAK international and The Waterloo Foundation (>£40k to Wilson and Vine, for implicit learning and attentional training with children with movement disorders); and (6) learned societies, such as the Physiological Society who provided support for equipment and research expenses (£10k each for Bailey and Barker). Since July 2013, Jones has been awarded a further $1.1m grant from Gatorade/PepsiCo to continue to develop sports nutrition research.

Researchers in **the PAHAL group** have, since RAE2008, been awarded £1.49m in total. This has included small grants from local and regional agencies and organisations such as Devon County Council (Active Devon, with an ESRC studentship), Regional Legacy in Arts and Youth Sports (RELAYS), Royal Devon & Exeter Foundation Trust Hospital (£18k for exercise testing with young cystic fibrosis patients), Sports Council for Wales (£123k for evaluation of physical activity promotion). Awards have also been received from businesses such as Unilever (£66k for GeneActiv accelerometer development), and charities such as Diabetes UK, British Medical Association, Heart Research UK, Royal Society, Nuffield, National Osteoporosis Society, Waterloo Foundation, and New Economic Foundation. Krustrup has received funding from FIFA (£82k) to investigate the health benefits of soccer for a variety of groups including sedentary women.

The PAHAL group has been involved in funded health service research for many years. Taylor (with Bristol colleagues) co-led intervention development for the largest pragmatic trial (N=361) to date on facilitated physical activity for depression (TREAD) in primary care, funded by NIHR-HTA (2005-2012). Taylor was PI for an HTA funded (£435k) pilot randomised trial (Exercise Assisted Reduction to Stop smoking; EARS) with 'hard to reach' smokers wishing to reduce but not quit. Taylor was co-PI (with Taylor - UEMS) and Hillsdon as co-applicant, for an HTA funded (£160k) systematic review on The Clinical and Cost Effectiveness of Exercise Referral Systems. Taylor is PI for an NPRI-4 funded trial (£295k) on the effects of integrating physical activity counselling into routine Behavioural Activation, delivered through 'Improving Access to Psychological Therapies Service,' also involving Hillsdon. Hillsdon was PI for two large pilot studies: The Four Hundred Area Pilot Study (Wellcome Trust, £409k) to identify the feasibility of linking postcode and environmental factors to physical activity; and the feasibility of a GP physical activity intervention (NPRI, £477k). Gracia-Marco was awarded a EU100k Marie Curie grant for research on adolescent bone health among osteogenic v. non-osteogenic athletes, and the effect of plyometric training on bone health.

3.2 Infrastructure: The growth in research income noted above has been achieved with University (e.g., RKT support with grant preparation, small 'Bridging the Gaps' interdisciplinary grants, Link Funds for developing business partnerships, The Exeter Science Exchange for developing collaborations), College (e.g., Strategic Development Fund), and SHS strategic support (e.g., Study Leave application process). This infrastructure has helped to support grant proposals and collaborations for SHS staff with industry (e.g., Unilever, GlaxoSmithKline, Gatorade/PepsiCo, Kelloggs, Flybe, Intuitive Surgical), national organisations (e.g., RFU, ECB, UK Sport, MoD), charities (e.g., Wellcome Trust; National Osteoporosis Society, Diabetes UK, Dunhill Medical Trust, Exeter Leukaemia Fund), Research Councils (e.g., ESRC, EPSRC, NIHR-HTA, MRC), and the EU (e.g., Marie Curie Career Integration Grant) for both the research groups. Prioritized support for research which involves RCUK and matched funds from other sources has made this support even more essential to compete for declining research funding.

3.3 Facilities: Our strategy to focus on the two internationally recognized research groups has led to further development of state-of-the-art facilities which have enhanced our reputation as one of the UK's leading Centres for the study of sport, exercise and health sciences. SHS staff have access to three large purpose-built laboratories with regularly updated ergometers, metabolic carts, a micro- and macro-vascular function NIHR funded Clinical Research Facility (with Gates), a body composition suite, environmental chamber, DEXA scanner, various experimental psychology resources (e.g. eye-tracking technology, EMG and EEG). Researchers from both BHP and PAHAL continue to use the MRI/MRS centre on the St Luke's campus (with Fulford), with a £44k annual investment for dedicated SHS research for one day a week. This facility has provided the environment for world-leading research in collaboration with colleagues in UEMS and Psychology. RKT start-up funds (>£200k) were used to support Krustrup and his team (Mohr & Jackman), and Bowtell to establish new wet lab facilities for muscle/blood biochemistry work (e.g., for analysis of muscle biopsies) and to purchase a coil and isotopes to develop ^{13}C-MRS technique. A large supply of GPS devices, and GT3x and GeneActiv accelerometers facilitate research in SHS on

physical activity patterns among sports participants, the general population and clinical groups. We have also used research income to purchase ultrasound equipment for vascular measures.

The facilities in CHERC have continued to develop since RAE 2008. CHERC was established in 1987 and received recognition in 1998 for its international eminence in paediatric physiology research with the award of the Queen's Anniversary Prize for Higher Education. The Centre works with local schools, clinicians, medical researchers and sick children. CHERC is housed in a suite of purpose-built laboratories, with dry and wet lab facilities, and capability for anthropometric assessment. The MRI/MRS centre has facilitated further world leading paediatric research.

SHS has 3 FT designated laboratory technicians and has full access to technical expertise in the MRI/MRS. Regular training courses are held covering health and safety, phlebotomy, and compliance with risk assessed procedures. Designated workstations are provided for all PGRs; each student has a PC and printer connections, and access to an excellent range of IT resources.

e. Collaboration or contribution to the discipline or research base

4.1 Background: Since RAE 2008, SHS academics have shaped, developed and received support from the University's Science Strategy. Taylor sits on the Translational Medicine theme board (www.exeter.ac.uk/research/excellence/keythemes/medicine/) which supported the appointment of Hillsdon to foster interdisciplinary research. Both contributed to a successful UEMS bid in 2011 for an NIHR National School of Public Health Research. SHS academics have also played significant roles in the establishment of interdisciplinary networks such as PenCORE and PARC in terms of both biomedical and social science research. The ESRC funded research capacity-building Centre for Sport, Leisure and Tourism (based in the Business School) involved Eston (former Head of SHS) as co-applicant and Management Board member, with Armstrong as Chair. Taylor is the Exeter lead for the ESRC funded inter-institutional (with Bristol and Bath) Doctoral Training Centre for the interdisciplinary pathway in Health and Well-being. Both academics and PGRs have contributed to and benefited from collaborations with colleagues in the Mood Disorder Centre, Biosciences and the UEMS, as part of a strategic aim to foster interdisciplinary research. Indeed, seven SHS PGRs (Day, Griffith, Haasova, Pavey, Phillips, Phoenix, Sheppard) have gone on to post-doctoral employment in PCMD or UEMS since 2008. In summary, the unit has grasped opportunities to share and strategically develop interdisciplinary research in collaboration with key partners since 2008 and plans to maintain this strategy to maximise research capacity and quality.

4.2 Collaborations with research users. The sources of funding identified above (3.1 and 3.2) provide numerous examples of external collaborations and highlight the strategic importance placed on collaboration by SHS. Over 20% (£450k) of our research income spent during the REF cycle was from industry, commerce and public corporations, and about 15% more came from NHS sources to support research. Much of the remaining externally and internally funded research also involved a very wide range of research users. Our Impact Statement and Case Studies describes how much importance we have placed on involving research users including commercial partners, the public and armed services, and sport-related organisations.

4.3 National & International collaborations

As our staffing strategy noted (1 and 3), national and international collaborations have been, and remain, vitally important. Applications for external support and University strategic support have been facilitated by the University's RKT Department. Dixon leads the self-sustaining Sportsurf (Sports Surfaces) Research Forum which was initially funded by an EPSRC grant. Wilson and Vine's international support grants to Hong Kong and the US, respectively, have helped to develop collaborations with Masters (Hong Kong) and colleagues in Holland and Canada (Vickers), on attentional training of surgeons, reducing falls in older individuals, and improving implicit learning in children with developmental coordination disorder. A number of national and international BHP collaborations were mentioned above, and have been significant in producing high quality outputs and impact (e.g., research by Krustrup and Jones) and leading to further funding. Among the PAHAL group, Taylor and Hillsdon collaborate with internationally renowned co-applicants to ensure the appropriate skill mix for conducting significant public health and health service physical activity research. For example, Taylor, as P.I. for an HTA funded trial, collaborates with Aveyard, West and Michie in the UK Centre for Tobacco Control Studies, and Hillsdon, as P.I. for the Wellcome Trust funded Four Hundred Area Pilot Study, collaborates with McIntyre and Bull. Krustrup, Mohr, Jackman and others work closely with colleagues at the University of Copenhagen

(e.g., Bangsbo, Hellsten and Saltin). Jones, Vanhatalo and Wilkerson collaborate with Poole (Kansas State University), Hogan (UC San Diego) and Burke (Australian Institute of Sport). Eston (University of South Australia) is an honorary professor.

4.4 Contribution to Discipline

SHS staff have contributed significantly to the wider development of the sport, exercise and health sciences both nationally and internationally over many years. Staff are encouraged to seek prestigious positions as international journal editors, grant reviewers, and through dissemination of research findings at national and international conferences. A number of leading journal editorial roles are held: Jones is Editor-in-Chief of *Eur. J. Sport Sci.* (2011-), Associate Editor for *Med. Sci. Sports Exerc.,* and *Br. J. Sports Med.,* and on the Editorial Board for 6 other international journals, including *J. Appl. Physiol*. and *Respir. Physiol. Neurobiol*. Krustrup is an Editor for *Eur. J. Appl. Physiol.* Taylor is co-founding Editor-in-Chief of *Mental Health & Physical Activity* (2008-). Armstrong, Bowtell, Dixon, Gracia-Marco, Hillsdon, Rees, Vanhatalo, Williams and Wilson are on the Editorial Board for leading journals in the field including *Med. Sci. Sports Exerc., Psych. Sport Exerc., Footwear Sci., BMC Public Health, J. Sports Sci., Int. J. Sports Physiol. Perform., Eur. J. Sport Sci., and Pediatric Exerc. Sci.*

Significant grant review roles are held: Hillsdon is on the HTA Review Board for Obesity, and the NICE core Public Health Advisory Committee; Taylor & Bowtell are in the HTA Peer Review College; and Wilson is in the ESRC Peer Review College. Across SHS, grant proposals are regularly reviewed for the MRC, ESRC, EPSRC, Diabetes UK, BHF (National Centre, programme grant), Research for Patient Benefit, Leverhulme and Wellcome Trusts, and internationally (e.g., Research Councils in Austria, Belgium, New Zealand and Singapore).

Major conferences were co-organised by Taylor (2009, 1st UK Soc of Behav Med/MRC-NPRI – with Greaves in UEMS), and Williams with Barker & Winsley (2011, 25th European Paediatric Work Physiology Conference). Over 30 workshops or invited symposia have been organised by SHS staff across the disciplines at significant conferences such as ACSM, ECSS, ISSP, and BPS (Clin Psych). Invited lectures have been delivered throughout the world such as in Canada (Jones - 'Hypoxia, 2013', awarded 'Reeves Prize for Presentation Excellence'), New Zealand (Jones - 'NZ Sports Medicine Memorial Trust Lecturer' for 2012), Malaysia, Japan, Italy, Turkey, Austria, Belgium, Portugal, Greece, France, Denmark, Sweden, Australia and the USA.

Academics and PGRs from Exeter have been acknowledged by BASES with the following awards: Elsevier Student Oral Presentation Award: Bailey (2009); Sportesse Sport Science Oral Presentation Award: Dixon (2013), Jones**,** (2009); and Routledge Recently Qualified Researcher Oral Presentation Award: Vanhatalo (2010). At the ECSS conference, the quality of PGR work was recognised with Young Investigator Awards for oral presentations by Coffee (4th, 2008), Bailey (1st, 2010), and Vine (5th, 2011), and for poster presentations by Winlove and Willcocks (3rd and 5th, 2010). BASES Expert Statements have also been co-authored by Barker & Williams, and Wilson. Moore (supervised by Dixon & Jones) received the Nike Award for Athletic Footwear Research ($25k) at the International Society of Biomechanics conference. Williams was awarded a British Council Researcher Links Workshop grant on 'Youth, Sport and Health - A Global Problem'.

Armstrong has had lead roles in producing International Olympic Committee consensus statements on the 'Health and fitness of young people through physical activity and sport', and 'Training the Elite Young Athlete'. Thirty-seven former CHERC researchers now have academic posts across the world, with 12 either Full or Associate Professors. In recognition of his contribution, in 2013 Armstrong received honorary doctorates from the Universities of Coimbra in Portugal and Brock University in Canada.

Armstrong, Jones, Taylor and Williams are all Fellows of BASES; Armstrong, Jones and Williams are Fellows of ACSM; and Armstrong and Jones are Fellows of ECSS.

4.5 PGR training collaborations

Previous sections have referred to the ESRC interdisciplinary South West Doctoral Training Collaboration in 'Health and Well-being,' established in 2011, which requires a cross-disciplinary supervision team (e.g., in Psychology, Geography, UEMS (2011-). Taylor is lead at Exeter and facilitates the identification of topics (and potential Great Western Research partnership funding) and supports applications for up to 2 students (MRes + PhD, or PhD) per year with Bristol and Bath (see: http://www.exeter.ac.uk/postgraduate/degrees/sport/healthmres/).