

Institution: University of Exeter
Unit of Assessment: 24 Sport and Exercise Sciences, Leisure and Tourism
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1 Overview</p> <p>Sport and Health Sciences (SHS) is one of four departments within the College of Life and Environmental Sciences (CLES) at the University of Exeter (see Institutional Level Environment Statement (hereafter ILES) 1.5). We are a UoA of 33.8 FTE located in three buildings on the St Luke's Campus, alongside the College of Medicine and Health (CMH), which provides important opportunities for interdisciplinary collaboration. We were ranked 3rd among 52 UoAs in REF2014 for research quality and intensity, and consistently rank among the top five sport science departments in the UK (e.g., 2nd in The Times and Sunday Times Good University Guide, and 3rd in the Complete University Guide in 2020). Our most significant achievements during the REF2021 period include:</p> <ul style="list-style-type: none"> ✓ Fostering talent and career development. We increased our FTE from 24.3 in 2014 to 33.8 in 2020 (a 39% increase). We supported staff to achieve 21 promotions over that period, including the first two female Professors at SHS. We achieved Athena Swan silver awards in 2014 and 2017. ✓ Substantial increase in research funding. We secured total awards of £6.5m over the REF2021 period compared to £3.1m in REF2014. Average award value per FTE per annum increased by 51% from £18.2k in REF2014 to £27.5k in REF2021. Global industry accounted for 34% (£2.2m) of our awards in the REF2021 period. ✓ Sustainable funder relations. Our growth in research funding is primarily based on sustainable relationships developed with UK and global industrial partners and the military, resulting in repeat funding from partners such as PepsiCo, the Defence Science and Technology Laboratory (Dstl), Quorn, Nike and Cherry Marketing Institute. ✓ Developing a vibrant impact portfolio. Engaged research has given rise to innovation and product development by industrial partners and resulted in the creation of spin-off companies/services (Cineon Training, Activity Informatics), evidencing the benefits we bring to our funders (see <i>Section 4.2</i>). ✓ Supporting PhD training and early career researchers (ECR). Our PhD completions increased by 47% during the REF2021 period, and in a major step-change from REF2014, our ECRs were awarded prestigious Fellowships by the Wellcome Trust, MRC, ESRC and the Royal Society of Engineering. ✓ Growing our global reach and reputation. We ranked 10th in the QS World University Subject Rankings 2020. We launched two formalised strategic partnerships with QS World top 100 institutions (University of Queensland and The University of British Columbia) (<i>Section 4.1.1</i>). <p>In this template we describe the environment that has built upon an already strong base from REF2014 to increase the scale, quality and profile of our research, and we lay out our future plans for addressing global challenges in health, sport, and other high-performance environments.</p> <p>1.2 Context and structure</p> <p>SHS's mission is to deliver world leading sport and health sciences research and teaching, underpinned by robust scientific methodologies, state-of-the-art facilities and strategic partnerships, ultimately driving policy change and improved health, performance and wellbeing for all societal groups. Since REF2014, new staff appointments in biomechanics, motor control psychology, and physiology and nutrition, enabled disaggregation of the former 'Bioenergetics and Human Performance' research group and the formation of two new groups of Integrative Physiology (IP) and Human Movement Science (HMS). Our research activity is thus now</p>

focused in three cognate groups which conduct impactful and interdisciplinary research along the continuum from clinical groups to elite performance (**Figure 1**). The IP group seeks to improve understanding of basic physiology and metabolism that underpins human performance in health and disease. The HMS group seeks to improve understanding of factors influencing human movement, focusing on both psychological and biomechanical determinants and interventions. The Health Across the Lifespan (HAL) group seeks to enhance our understanding of the relationship between physical activity and health across the human lifespan, and includes the Children's Health and Exercise Research Centre (CHERC). Importantly, our groups are coalitions of activity and research interest rather than silos with fixed memberships. Collaborations across research group boundaries are encouraged and indeed commonplace.

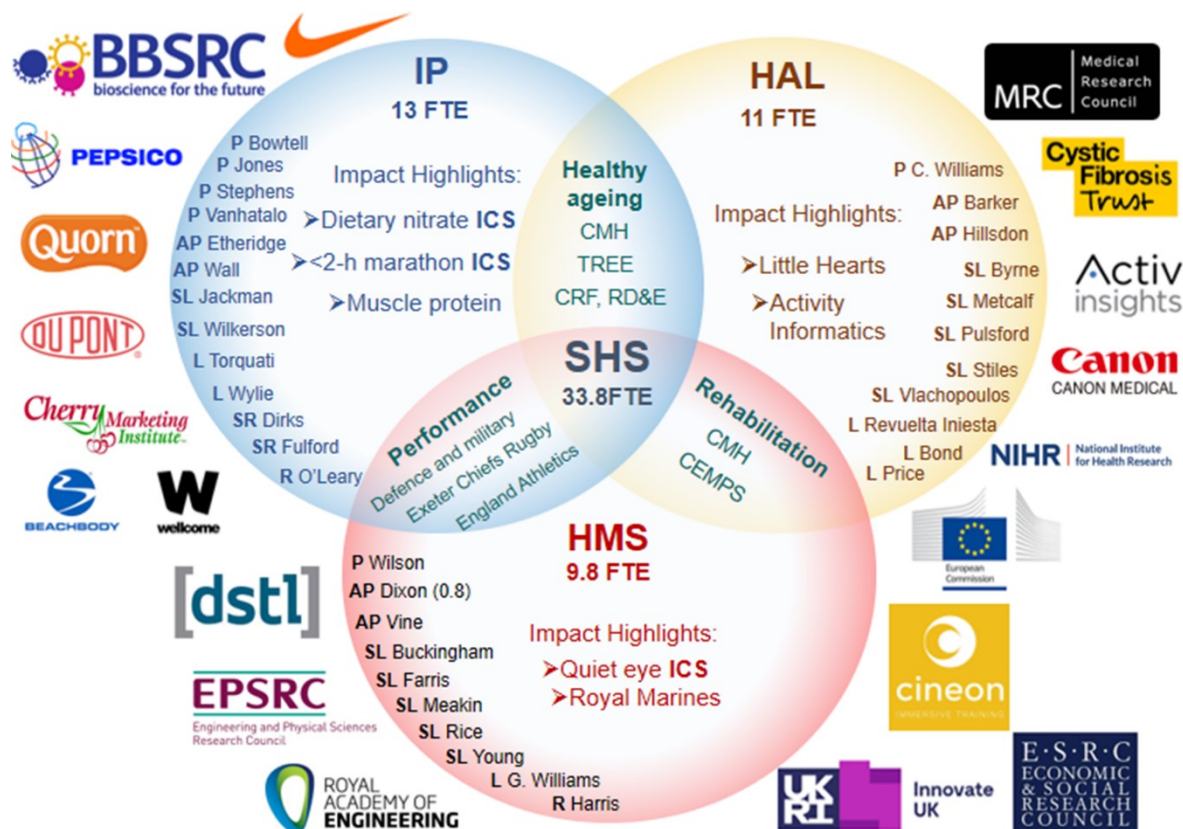


Figure 1. Sport and Health Sciences (SHS) at a glance. 33.8 full-time equivalent (FTE) staff form 3 overlapping and complementary research groups: Integrative Physiology (IP), the Health Across Lifespan (HAL) and Human Movement Science (HMS). Impact generation is endemic across all groups and major funders include UK government, sports nutrition industry, and charities. Key interdisciplinary partners include Colleges of Medicine and Health (CMH) and Engineering, Mathematics and Physical Sciences (CEMPS), Translational Research Exchange @Exeter (TREE), Clinical Research Facility (CRF), and the Royal Devon & Exeter NHS trust (RD&E). P=Professor, AP=Associate Professor, SL=Senior Lecturer, L=Lecturer, SR=Senior Research Fellow, R=Research Fellow, ICS=REF2021 Impact Case Study.

1.3 Research integrity and open science

A commitment to research ethics and research integrity, enshrined in the Concordat to Support Research Integrity and Researcher Development (ILES 2.9), governs all our research activities. New staff undergo mandatory training on 'Research Integrity', 'Data Security' and 'Open Science'. The SHS Ethics Committee reviews all research conducted at the department, with a small proportion of studies requiring approval from the MoD or NHS Ethics Committees. We have made a concerted move towards an **open science culture** and the use of **responsible metrics** (ILES 2.8). Exeter became a signatory of DORA in 2020. Open Science is now a standing item on our Research Strategy Group monthly meetings. SHS has appointed staff (**Buckingham**) and

post-graduate research student (PGR; **Hassan**) as Open Science ‘champions’ who represent the UK Reproducibility Network. SHS PGR students initiated an Exeter branch of the [RIOT](#) Science Club (*Reproducible, Interpretable, Open, and Transparent Science*) in 2020. Our staff are 100% ORCID registered and we received £43.7k of internal open access funding during this REF period. *Open Research Exeter* (ORE) is among the UK’s top 10 repositories for research data and outputs. The overall success of our Open Access policies is evidenced by the >16-fold increase in the annual number of ORE downloads of SHS outputs: from 2,700 in 2014 to 45,200 in 2020, totalling 170,700 downloads during the REF period.

1.4 Research and impact strategy 2014-2020

In REF2014, we ranked 3rd for GPA*intensity but 7th for research power, a consequence of our smaller size compared to the institutions ranked above us. The strategy we articulated in REF2014 was to increase research power and complementary expertise within research groups (**Figure 1**), and to make our research more sustainable by supporting the next generation of researchers.

1.4.1. Sustainability of our research

We met our REF2014 aim of enhancing sustainability and increasing research power via the following mechanisms:

1. **Attracted (and developed) staff** with the potential to be internationally leading researchers in areas that support our core research interests (see *Section 2*).
2. **Attracted and supported the best PhD students and Research Fellows** as future research leaders and the engine room of research activity. This has resulted in a 70% increase in PGR enrolments (to 102 in 2019/20), and an 80% increase in the number of post-doctoral Fellows (24 appointments during REF period) including the award of 4 prestigious Fellowships (see *Sections 2.4 and 3.1.4*).
3. Created **strategic interdisciplinary collaborations** with other departments within the university to drive 4* publications. 42 % of our REF outputs are with co-authors from outside our unit of assessment, and 14% of outputs are interdisciplinary (*i.e.*, research that would not be possible by SHS researchers alone).
4. **Developed and consolidated international collaborations with world-leading universities** in order to enhance our international profile and drive 4* research outputs (see *Section 4.1*). The success of these strategic activities is evidenced by us submitting 54% of outputs with *international* partners and climbing from 25th to 10th in the QS Top University Guide over the last three years.
5. Enhanced our **research environment** with over £2m of internal investment into new facilities to facilitate research likely to result in the most original, significant, and methodologically rigorous outputs (see *Section 3.2*).

1.4.2 Increased research Income

Our goal was to double our research income and we exceeded this, securing total awards of £6.5m over the current REF period compared to £3.1m in REF2014 (see *Section 3.1* for highlights). Critically, from a sustainability perspective, this increase in awards was not just driven by a few senior academics – in the last 24 months, 89% of our REF-eligible staff had an active award and every eligible staff member submitted at least one application. Our annual research income rose by 127% from 2013/14 to reach £1.0m p.a. in 2018/19. Despite Covid-19 disruption we achieved total awards of £1.1m and £25k per FTE research income in 2019/20 (*cf.* £13k/FTE in 2013/14) highlighting a healthy funding portfolio for the coming years.

Our key strategy for achieving this goal was to support staff in submitting more and larger grant applications. We sought to maintain a balanced portfolio of funding sources and to build sustainable relationships with funders (*e.g.*, Dstl, Nike, PepsiCo, Quorn; see *Section 3* for specific activities). We focused on areas that matched our research expertise and the strategic priorities

of the external funding environment (e.g., UK Government Industrial Strategy): (1) *Food, Nutrition and Health*, (2) *Human Health Across the Lifespan*, and (3) *Defence and Security*.

1.4.3. Impact generation

Our stated aim was to sustain a rich, agile and responsive culture in which our academic researchers actively seek opportunities to engage with non-academic users and beneficiaries, delivering impact in society, sporting organisations and business. In this REF period, all research groups have carried out 'engaged research' (see *Section 3* for engaged research funding and *Section 4* for end-user engagement).

The key strategic initiatives launched to drive and support our impact agenda were:

1. The appointment of a Director of Impact (**Stephens**, 2016) to lead a culture that ensures that impact is embedded within all our research activity;
2. The appointment of a dedicated Impact and Partnership Development Officer for SHS (since 2014) to support our impact work and facilitate access to university-wide training opportunities.

Highlights of impact and engaged research successes include:

1. The development of *five* fully-fledged **impact case studies** (ICS) over the REF period which evidences the depth of our research impact on policy, clinical practice and training, and human performance (see *Section 4.2*). Following a rigorous review process in accordance with the university's **Equality, Diversity and Inclusivity (EDI)** principles, our most mature ICS on 'Quiet eye' virtual reality training to enhance performance in stressful environments, the 'Breaking 2' marathon project, and dietary nitrate as an ergogenic aid were chosen as our three representative REF2021 ICS (as required for 33.8 FTE).
2. The creation of a **start-up company** (Cineon Training, 2017) to deliver Virtual Reality training in safety-critical industries in partnership with the HMS group. Employing four full-time staff and up to 20 freelancers, Cineon Training has already secured 15 training contracts worth £150k. The HAL group launched a **spin-out service** (Activity Informatics, 2019) with the company Activinsights that specialises in physical activity data for clinical trials (income to date £122k).

1.5 Future research and impact strategy to 2027

We have been successful in creating a world-leading research environment and in providing the resources required for staff to reach their potential. We are responding to emerging challenges by continuing to focus on our distinctive areas of strength, namely, people-focused culture, interdisciplinarity and industry partnerships, that will deliver real-world impact and maintain our position at the forefront of sport, performance, and health sciences research. Our aims have been developed in accordance with the University of Exeter's Research and Impact Strategy 2020-25 (**ILES 2.1-2.9**). **Our overarching aim is to ensure that our globally-connected research environment is one in which staff and researchers of all backgrounds and at all career stages can flourish.** We will take advantage of the momentum created over this REF period to consolidate and increase our research power, income generation, and impact.

1. **Fostering an equitable and supportive research environment.** Our aim is to maintain an inclusive ethos in which the contributions of all researchers at different career stages, and in different subject areas are valued and celebrated. **EDI** (see *Section 2.3*) in research environments demands ongoing processes of action and reflection. Our commitment to building on good practice is evidenced by Athena Swan Silver awards (2014 and 2017). Prioritising the wellbeing of the SHS research community has been a strength of the department and remains key to ensuring the vitality of our research environment.
2. **Research power.** To implement the university's research and impact strategy (**ILES 2.2-2.4**) at SHS, we aim to expand on our expertise in **nutrition** and **healthy ageing** as these: (1) match UKRI strategic funding priorities for *Global and Industrial Strategy Challenges*; (2)

expand areas of *research strength* that support our vision for a 'Health Campus' alongside CMH; (3) drive forward interdisciplinary (e.g., CMH, Biosciences, Living Systems Institute (LSI), Translational Research Exchange @Exeter (TREE)) and international collaborations (e.g., QUEx Institute); and (4) support new *education developments* in nutrition and dietetics, physiotherapy, and sport and exercise medicine.

3. **Research Income.** We will focus on: (1) global industrial investment in *Nutrition* research for health and sport performance, (2) UKRI, NIHR and charitable peer-reviewed funding for *Healthy Ageing* research, and (3) funding for defence, security, and space flight research. We aim to *grow a balanced portfolio of research funding* from different sources, with emphasis on industry collaborations with high research impact potential, taking advantage of interdisciplinary partners at Exeter (CMH, College of Engineering, Mathematics and Physical Sciences (CEMPS), LSI, and the Institute for Data Science and Artificial Intelligence (IDSAI)), as well as our growing global network of partner institutions (see *Section 4.1*). These strategies will facilitate successful larger value grant applications and awards.
4. **Impact.** SHS has a strong track record of impactful research in high performance sport, nutrition, and human health. Our strategy is to support continuous development of nascent relationships from engaged research into real-world impact. Examples of impact development currently in mid-early stages with potential to form mature ICS for the next REF assessment include: Plant-based, environmentally friendly sources of dietary protein to maintain healthy muscle mass (**Wall**, IP group); Military footwear development with the Royal Marines and injury prevention with Exeter Chiefs Rugby (**Dixon, Rice**, HMS group); and the 'Little Hearts' project on exercise prescription for children with congenital heart disease (**Barker, C. Williams**, HAL group) (**Figure 1**).

2. People

A key element of our success since REF2014 has been a focus on developing our people to maintain a vibrant research culture for individual and collective benefit. SHS has developed a very strong identity and sense of belonging – evidenced by our university-leading scores in the 2016 and 2018 Employee Engagement Surveys – and our long history of collegiate culture has been critical to our sustainability. In recognition of exceptional contributions to the university recognised by colleagues, SHS staff were rewarded with 9 'Above & Beyond' Gold and Silver awards during the REF period. All our research groups are internationally recognised as centres of excellence and all have contributed to the research successes of the unit: from funding, to outputs, to the development of impact case studies.

2.1 Staffing strategy

Our people and staffing strategies are consistent with the university's **Researcher Development Concordat (ILES 3.8)** and are informed by a clear ambition and goal: that SHS at Exeter will be recognised by all relevant research communities, in the UK and globally, as a vibrant and supportive environment in which to build successful research careers. This involves maintaining a research environment that talented academic researchers from all backgrounds are eager to join; and one in which all researchers can flourish, reach their potential, and in turn help to nurture the development of others. This section will outline our staff-related strategies, policies and achievements in this REF period.

2.1.1 Growth in staff numbers

A key success for us in this REF period was the investment in new staff, enabling a 39% increase in REF-eligible staff to support research power and the sustainability of our research culture. Our primary recruitment strategy was to attract staff with exceptional research **potential** to complement and expand our expertise, and then support their **development** as world-class

researchers. Across the REF period, we appointed 16 REF-eligible staff: 1 Associate Professor (**Stephens** – IP), 4 Senior Lecturers (**Buckingham, Byrne, Farris, Young** – HMS) and 11 Lecturers (**Bond, Gracia, Revuelta Iniesta, Price, Vlachopoulos** – HAL; **Etheridge, Wall, Torquati, Wylie** – IP; **Rice, G. Williams** – HMS). Despite the retirement of 1 Professor and 2 others moving institutions, and only appointing 4 staff at SL level and above, we moved from a 'bottom heavy' staffing structure in REF2014 **to a more balanced structure capable of delivering our strategic aims** during the REF2021 period (**Table 1**). This shift in staffing structure through a process of 'developing our own' stems from an energetic, collegiate culture promoted within SHS, where senior academics act as role models and staff provide mentorship to colleagues at earlier career stages. There has been a notable increase in the proportion of REF-eligible staff identifying as female from 21% in REF2014 to 38% in REF2021 (steady from 2016/17 to 2019/20), while our proportion of female research-only staff has been consistently around 50% throughout the current REF period.

Table 1: Census date profile of REF-eligible staff full-time equivalents for REF2021 compared to REF2014.

Grade	REF2014 FTE (female/male)	REF2021 FTE (female/male)
Professor	5.3 (0/5.3)	6 (2/4)
Associate Professor	4 (1/3)	5.8 (0.8/5)
Senior Lecturer	4.6 (1.6/3)	12 (4/8)
Lecturer	9 (2/7)	6 (4/2)
Research only	1.4 (0.4/1)	4 (2/2)
Total FTE	24.3 (5/19.3)	33.8 (12.8/21)

2.2 Staff development

2.2.1 Early career researchers (ECRs): Lecturers and Research Fellows

As we started the REF period with a high proportion of new staff at Lecturer-level (89% of whom were commencing their first permanent academic appointment), our primary focus was on supporting this cohort of new researchers and helping them to establish independent research careers. New academic staff members have a reduced teaching and administration load in their first two years, allowing them to concentrate on getting their research underway. New Lecturers are supported through the university's Professional Development Programme, which sets specified goals for research, teaching and wider academic contributions. New Lecturers agree targets with the Head of Department (HoD) within 4 weeks of appointment, and these are reviewed annually to ensure that staff pass probation or are promoted as soon as the criteria are met. Of the 11 promotions from Lecturer to Senior Lecturer in SHS over the REF period, 9 occurred before the stipulated 5-year progression period, and 4 Associate Research Fellows were promoted to Research Fellows following performance review during fixed term contracts.

The increase in research income has resulted in a substantial increase in our number of research-only staff, increasing from 4 at the end of the last REF period to 9 on the REF2021 census date (*N.B.* 4 out of 9 – **Dirks, Fulford, Harris, O'Leary** – were Cat-A and included in REF2021 submission). Research Fellows have equal access to discipline-level funds to support their independent research and they are represented on key discipline-level committees. Research Fellows receive confidential mentoring by a senior colleague ('Academic Lead') who is not a member of their own research group; peer support through our *Early Career Researcher Network*; opportunities to gain teaching experience and to supervise post-graduate students; personal development and training plans; and guidance on grant proposal development from experienced colleagues and our Research Development Manager. They are also provided with defined criteria for progression to permanent positions, and where possible, proleptic appointments (*e.g.*, **Dirks**). We have had considerable success in 'growing our own' through the positive impact of our

nurturing culture, with 7 former Research Fellows or PhD students gaining lectureships in SHS since 2013 (3 female).

2.2.2. Mid-career and senior researchers

While most of our efforts in this REF period were in supporting ECRs through the early years of their careers, Academic Leads and senior management also provided significant support to more established researchers. We had a 100% success rate in promotion boards to AP (n=6) and Professor (n=4). Characteristic of the vitality of the SHS culture, senior academics have volunteered for university leadership positions (e.g., **Jones** – Assistant Deputy Vice-Chancellor for Business and Innovation, 2019-current; CLES Associate Dean for Research and Impact, 2015-2018; and **Bowtell** – CLES Associate Dean for Global, 2020-current), and a succession pipeline has meant that other staff have been keen to step up and grasp the opportunity to provide strategic direction for the department (e.g., **Bowtell** HoD 2015-20; **Wilson** DoR 2018-20, HoD 2020-current; **Vanhatalo** DoR 2020-). Our staff have benefitted from leadership training for senior management (e.g., HoD Engagement Events), as well as the college-funded 'Aurora' Advance HE's Leadership Development Programme for Women (**Jackman, Rice**).

2.2.3 Career development policies and support

Our approach to support career development for our researchers involves a diverse mix of opportunities and mechanisms, tailored to career stage, and was developed in line with the university's Researcher Development Concordat commitment to supporting research careers at all levels (**ILES 2.9**). The introduction in 2016 of the university-wide 'Exeter Academic' system for career development has transformed the probation procedures, led to revised criteria for promotion to better capture achievements in impact and engaged research, and ensured that academic staff do not suffer detriment to career development or promotion due to Covid-19 (**ILES 3.3**).

Each staff member's progress and plans for research, impact, teaching, and internationalisation are reviewed annually through the university's Performance and Development Review scheme by their Academic Lead (a mentor from a different research theme). All staff are supported to apply for relevant promotion by their Academic Lead when promotion criteria are met (*i.e. we have no quotas and no minimum time periods*). Discussions are then held with the HoD, followed by the staff member preparing draft paperwork for feedback from HoD and the College Pro-Vice-Chancellor. This system has enabled senior staff to engage in robust succession planning with respect to key research-related roles.

2.3 Equality, diversity and inclusivity (EDI)

Our **EDI training compliance** has been 100% since 2014. All staff involved in **REF selection panels** for outputs and ICS received REF-specific training in avoiding Unconscious Bias, and our output submissions were adjusted following EDI evaluation to ensure equity.

We are one of only four UK sport science departments to hold the **Athena Swan Silver** accreditation (2014 and 2017). A core element of our EDI strategy in 2014 was recognition that researchers identifying as female were progressively under-represented in more senior staff cohorts. We promote gender parity throughout the research pipeline and continue to make strong progress in this respect (**Table 1**). Since 2014, 2 women have been promoted from L to SL (36% of promotions), 2 to AP (33% of promotions), and 2 to Prof (50% of promotions).

The SHS Athena Swan working group formed during the REF2014 period, led by **Bowtell**, was renamed in 2016 as the **SHS EDI Committee** which is responsible for the implementation of the university's EDI Vision 2025 (**ILES 3.14-3.15**) through workshops and training opportunities. We nurture a positive culture and awareness of EDI issues through the following activities:

- Staff **wellbeing** is supported through Occupational Health Service, the provision of a 24/7 counselling service for telephone and face-to-face counselling. SHS initiatives to support a positive work environment include weekly coffee mornings which were continued digitally during the Covid-19 pandemic, and annual staff away days focused on team building.
- In recognition of SHS EDI initiatives, **Dixon** was appointed to a College-level EDI role as the CLES Inclusivity Representative (2016). As part of this role she drives initiatives to promote **LGBT+ inclusivity** across SHS and the university (**ILES 3.15**).
- We are working towards **Race Equality Charter** accreditation in 2021 (**ILES 3.15**), with a growing SHS EDI focus on the representation and inclusion of Black and Minority Ethnic (**BAME**) researchers in our community.
- We use the university's SWARM workload allocation tool to ensure **transparency and fairness in workload allocation**. SHS applies the university's flexible working policy that enables staff to effectively organise their time. Our staff benefit from teaching restriction requests and flexi-working to manage caring responsibilities, as well as fractional contracts and a Career Break Scheme.
- A focus on ECR support (*Section 2.2.1*) and fixed-term/part-time research-only staff through focused mentoring by senior academics for progression to personal fellowships.
- SHS provides a supportive environment for those returning to work after absences, including adjustments to working patterns. Twelve academic staff have benefitted during this REF period from the university's sector-leading **parental leave** which is provided regardless of length of service with the university (**ILES 3.16**).
- Recruitment panels for staff and research students have a **gender balance** and a member tasked specifically with ensuring EDI issues are considered in shortlisting and selection, including the use of gender-neutral language. Staff also receive training in avoiding Unconscious Bias, and this training is compulsory for all senior management positions.

2.4 Research students

The training of exceptional PGR students has been central to SHS's research strategy across this REF cycle. The importance of PGRs to our research generation is evidenced by the fact that **34% of our REF2021 outputs were co-authored by PGRs** and that former PGRs have held post-doctoral (n=12) and/or lecturer (n=10) positions in SHS during this REF period. Our diverse PGR cohort originates from 16 different countries, and 39% of our PGR enrolments (from 42% of applications) during the REF2021 period were female.

2.4.1 Growth in research student numbers

There has been a strategic move away from the department-funded Graduate Teaching Assistant model, towards competitive UKRI and industry funded PhD studentships, and **Doctoral Training Partnerships** (DTPs with ESRC, EPSRC, BBSRC and MRC; **ILES 1.8** and **3.8**). This is evidenced by a **thirteen-fold increase in the number of external partners funding PhD research** from REF2014 to REF2021. A major advantage of our new PGR strategy has been that it has enabled us to initialise **collaborative and interdisciplinary research partnerships**. Over this REF cycle, 44% of our PGRs have had external funding (whether from UKRI, industry, charity, or international governments) and 50% had supervisors from outside the department. We have been able to increase both the quality (competitive calls) and quantity (**Table 2**) of our PGR students, which is important as we seek to deliver on our strategic aim of developing future research leaders in sport and health sciences. Our PhD completions increased by 47%, from 35.6 during the REF2014 period to 52.4 during REF2021.

Table 2: PGR enrolments and PhD completions assigned by supervisory rating. All completions are PhD-by-research. We do not provide professional doctorates.

Year	13/14	14/15	15/16	16/17	17/18	18/19	19/20	Total
PGR Enrolments (HESA)	60	62	59	71	75	93	102	522
PhD Completions	8.1	13.8	4.0	6.8	5.5	8.3	5.9	52.4

2.4.2 PGR progression and support

PGR students are selected through a competitive process, involving a project proposal and interview. Students are initially enrolled as MPhil students and pass an upgrade process (including a *viva voce*) within 12 months of enrolment to progress to PhD registration. All students have at least two internal supervisors, who complete mandatory PGR Supervision training and continued professional development provided by the Doctoral College. Supervision is monitored via an online 'MyPGR' system. Progress is also reviewed annually by SHS's Director of Post Graduate Research (**Barker**), where issues raised confidentially by students or supervisors are addressed.

The university's Doctoral College oversees quality assurance and discipline-level reviews, informed by the annual Postgraduate Research Engagement Survey (PRES). All PGR students complete a **training needs analysis** on an annual basis with their supervisory teams. Bespoke skills training takes place within research groups, and students may attend taught MSc modules. The Doctoral College ran 759 Researcher Development Program sessions (**ILES 3.9-3.13**) during the REF2021 period and 83 SHS students attended 170 sessions, averaging 2 sessions each. During the Covid-19 pandemic, **Barker** organised PGR support through 'PG tips' virtual sessions; thesis submissions and viva examinations were rapidly transformed into digital format; and students were given the option to delay scheduled examinations and apply for extensions to period of study.

Students without a **research training support grant** from their funder receive a support grant from the College. Part of this fund is devolved to PGR student representatives to be used to support training and social events. All MPhil/PhD students have a desk and computer in a shared office. All students receive pastoral tutoring (**Hillsdon**) independent of the supervisory team, and peer-mentoring from other PGRs. We have created scholarships for female Home UG students to progress to PGR positions, paid maternity leave is available for all funded PGRs, and candidates can register for part-time attendance to support flexible working.

PGR students within the unit report high levels of satisfaction: overall satisfaction on the PRES is 89% (sector average = 81%), and this is particularly strong in terms of their 'Research skills' (94.4%) and 'Professional development' (83.3%). PGR students participate in the life of the department through representation at the SHS Research Strategy and EDI Groups and the College staff-student liaison committee. PGRs play an active role in social events and departmental research talks. They organise the annual SHS PGR conference, and frequently win awards in leading national and international conferences (see *Section 4.1.1*).

3. Income, infrastructure and facilities

The growth experienced in SHS over this REF period was underpinned by significant increases in income generation and investment in infrastructure.

3.1 Major research income

During the REF period, the department was awarded over £6.5m in competitive grant funding from a broad range of sources (**Figure 2**). This includes over £3m from UK and international industrial partners; £1.4m from UK-based charities; £1.2m from the UK government; £777k from UKRI; and £135k from various EU sources. These successes were borne out of a strategy that sought to target three primary sources of income that matched our research expertise and staff research goals to our funders' priority areas. Our most notable funders by award value are highlighted below

3.1.1. Food, nutrition and health

Our reputation as a world-leading centre for research into nutrition, health and human performance is evidenced by the significant funding invested by large international corporations in research designed to test the efficacy of their nutritional products. Major successes for the **Integrative Physiology** group include repeat funding from: (1) *PepsiCo*; first to **Jones, Vanhatalo** and **Wyllie** (£881k 2014-18) and then to **Bowtell, O'Leary, and Jackman** (£130k, 2019-21) to test the

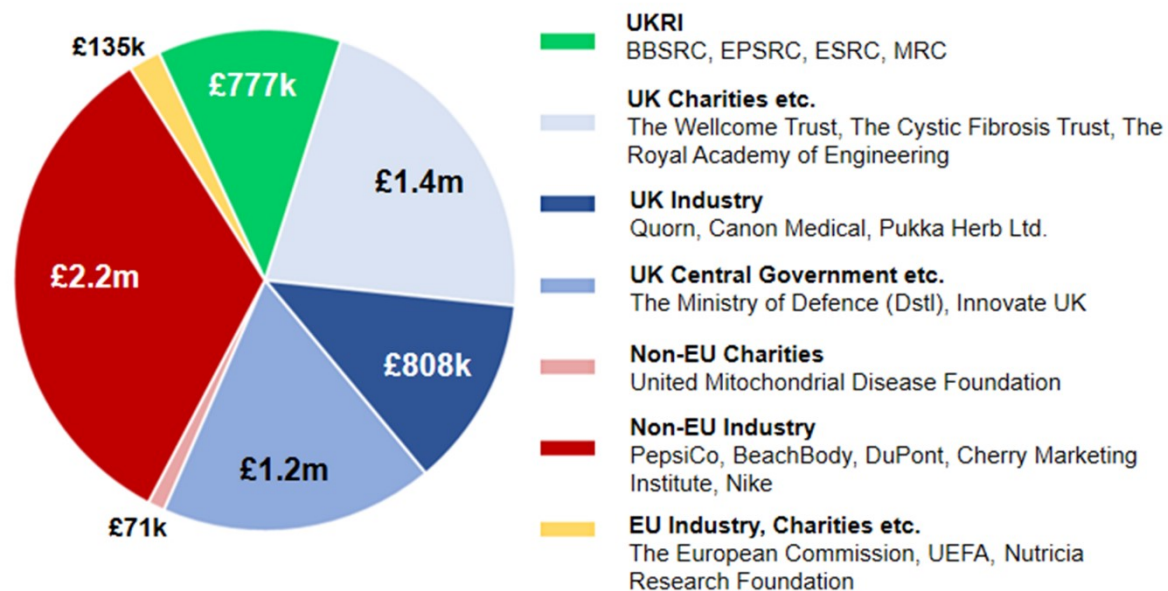


Figure 2. SHS total awards (£6.5m) during the REF period by funder type, with key funders indicated.

efficacy of new sports supplements; (2) *BeachBody* (£485k, 2016) to **Stephens** to explore nutritional strategies that improve exercise performance and recovery; (3) *Cherry Marketing Institute, Zumo Cacao* and *Pukka Herbs* (£335k, since 2014) to **Bowtell, Jackman and O'Leary** to explore the health and performance benefits of natural nutraceuticals; and (4) *Quorn* (£392k since 2014) to **Wall** to evaluate the efficacy of mycoprotein as an alternative protein source to support muscle metabolism.

3.1.2. Healthy ageing

A key element of our healthy ageing research has been the study of muscle maintenance, which complements the *Food, Nutrition and Health* funding stream. Our early career staff have secured prestigious fellowships to investigate mechanisms underlying muscle disuse atrophy: A Sir Henry Wellcome Postdoctoral Fellowship awarded to **Dirks** (£250k, 2018-22), and an MRC Skills Development Fellowship to **Deane** (a non-Cat-A Research Fellow) (£333k, 2019-22).

A *BBSRC Industrial Partnership Award* with *DuPont Nutrition & Health* (£571k, 2017-21) to **Jones** and **Vanhatalo** has supported cross-discipline research with CMH and Biosciences to study the influence of host-microbiome interactions with diet and cardiovascular health in older age. **Etheridge** has received funding from *BBSRC* (£192k, 2016), the *US Army Research Office* (£50k, 2019) and the *United Mitochondrial Disease Foundation* (£143k, 2019) to explore a range of genetic and pharmaceutical interventions utilising the *C. elegans* worm as a model of human ageing, disease and muscle health. Human clinical trials by **Etheridge** on muscle maintenance across the lifespan have been supported by the *Dunhill Medical Trust* (£63k, 2016) and the *Wellcome Trust* institutional strategic funds (£20k, 2016, 2019).

The other key element of our human health funding strategy has focused on the measurement and maintenance of functional physical activity. **Hillsdon** is a collaborator in MRC-funded research into identifying physical activity patterns important for patient outcomes after knee replacement surgery (£43k, 2019), as well as research into the genetic bases of sleep patterns (£32k, 2016).

Hillsdon is also part of an NIHR-funded multicentre collaboration investigating a *home-based rehabilitation intervention in patients with heart failure and their caregivers*. A recent Fellowship award from the ESRC (**Ellmers**, a non-Cat A Research Fellow; £105k; 2020) to the **HMS** group seeks to better understand how anxiety might influence falls in older adults.

Within the **CHERC** group, **Williams** and **Barker's** funding (£620k, since 2014) from the *Cystic Fibrosis Trust*, *Heart Research UK*, *Sport England* and *Vertex Pharmaceuticals* has enabled the creation of a strategic centre comprising an international, multidisciplinary team of academics to conduct research to help healthcare professionals better prescribe physical activity for young people with cystic fibrosis. This group have also recently partnered with *Canon Medical Systems* (£178k, 2019) to investigate cardiac function, health and fitness in children with congenital heart disease. **Vlachopoulos** is part of a new EU European Research Council Horizon2020 multicentre trial 'Science Engagement to Empower Disadvantaged Adolescents; SEEDS' to engage adolescents from deprived neighbourhoods in designing lifestyle interventions to improve health (£181k, 2020).

3.1.3. Defence and security

Within the **HMS group**, repeat funding from *Dstl* (£703k, since 2014) for **Vine and Wilson** has supported a range of projects designed to explore forms of cognitive training for military users performing in stressful environments (including feed-forward eye movement training, working memory training, and virtual reality applications), and for **Farris** (£48k) to explore the potential benefits of exoskeletons for defence applications. A *Royal Academy of Engineering Fellowship* awarded to **Harris** (£192k, 2018-2020), has supported the development of virtual reality training for threat detection for the intelligence community and Metropolitan Police and contributed to ICS development (*Section 4*).

3.1.4. Support mechanisms for research funding

As summarised in *Section 1*, these successes were founded on strategic plans to enable us to *target higher value, longer term grants*. Specific strategies designed to provide more support across the entire 'lifespan' of the income generation process have been important in this regard:

1. We have a Research Development Manager embedded within the department to help identify strategically important funding opportunities and to support staff in funding bid development.
2. We received particular support from the university's Innovation, Impact, and Business (IIB) team (**ILES 4.8**), as we have both a 'Health, physical activity and nutrition'-facing and a Defence-facing business partner to help identify and develop opportunities; plan and coordinate our engagement with industrial partners; and support applications to potential funding sources. We have built strong relationships with a number of organisations (e.g., Memoranda of Understanding with *Dstl* and other defence contractors) which has meant that we have been able to influence their funding strategy and increase our chances of securing repeat funding.
3. We have been successful in securing funding from the College Strategic Research Development fund to pump-prime and support strategic research developments beyond the scope of the SHS research budget (£132k over the REF period). For example, £21k to **Vanhatalo** supported the purchase of a nitric oxide analyser that facilitated pilot testing to support the subsequent successful BBSRC-IPA application.
4. To improve the quality of grant applications and to respond to UKRI demand management, we have a rigorous internal review process for grant applications. Following informal rapid peer feedback on viability and ways to develop ideas from within their research groups, potential applicants submit a draft application to an internal review panel for feedback and revision before the submission is approved. Examples of previous successful applications are made available where possible.

5. We target prestigious post-doctoral Fellowships as a source of esteem and a high value source of funding. We currently have four Fellowships in the department (having not had any previously): **Deane** (MRC Skills Development Fellowship; 2019-22); **Dirks** (Sir Henry Wellcome Postdoctoral Fellowship; 2018-22), **Harris** (Royal Academy of Engineering Fellowship; 2018-20); and **Ellmers** (ESRC Fellowship; 2020-21). In each case considerable support was provided from within and outside the department, including proposal support and interview practice. For example, with **Harris**, the College provided additional funding to extend a previous funded fellowship from Dstl by 6 months, in which time the independent fellowship application was written.

As a department in a research-intensive university we benefit from access to ring-fenced fellowship funds (e.g., MRC skill development training, ESRC Impact Acceleration Accounts); grant support, from workshops and sandpits to post-award administration; IIB support on impact activity, developing resources, business and commercialisation schemes; and time allocated on the workload model to conduct income-generating research activities. Central support staff provide tailored support for SHS staff for identification of funding opportunities and development of applications. All new appointments are given a start-up fund (£20-£40k) in order to kick-start their research at Exeter.

3.2 Infrastructure and facilities

SHS activity occurs primarily in three buildings on the St Luke's Campus – Richards Building, Baring Court and South Cloisters. Applied and population research occurs in the field (e.g., using accelerometers, HAL group; or Virtual Reality equipment, HMS group). Our bespoke research laboratories are supported by seven technicians. As of REF2014 we had six exercise physiology laboratories, a blood analysis laboratory, a body composition laboratory, a vascular physiology laboratory, a dynamometry laboratory, and a gait laboratory.

Sustained SHS grant capture during the REF2021 period has been rewarded by **university investment of over £2m to enhance facilities and research capability**. Major investments include:

1. Significant wet laboratory developments at Baring Court, match-funded by the College and industry partners (e.g., £220k for the unique combination of an environmental chamber to house an Agilent Seahorse Xfe24 cellular energetics analyser and cell culture facilities in 2014).
2. £620k of capital funds from the university to increase our **Integrative Physiology** capabilities at Richards and Baring Court to support research linked to Healthy Ageing themed calls (e.g., new exercise physiology, bed rest, neuromuscular function, and biochemistry laboratories, and a facility for **Etheridge's** *C. elegans* work co-funded by UK Space Agency and BBSRC).
3. £950k in 2018 to build a new, state-of-the art suite of laboratories in South Cloisters to support research into nutritional interventions to benefit health and performance (including further exercise physiology and bed rest laboratories, a gym to deliver bespoke training interventions, analytical labs, and a research kitchen for food preparation).
4. An investment of £330k from the Internal Equipment Fund (**ILES 4.20**) in 2019 to support the creation of two laboratories to support grant applications for the **HMS group**: a new gait lab including an advanced instrumented treadmill and motion capture facilities to support clinical research in rehabilitation and prevention of falls; a skill acquisition laboratory; and a virtual reality laboratory to support a number of projects funded by Innovate UK and in association with our consultancy partner, Cineon Training.

SHS also benefits from access to several university services and core facilities that are integral to our interdisciplinary research themes:

1. A new 3T MRI/MRS and PET-CT scanners suite at the Mireille Gillings Neuroimaging Centre, created with a £10m philanthropic investment (**ILES 4.13**), that supports research into muscle bioenergetics and oxygenation (IP), and brain perfusion and function (IP, HMS).
2. Exeter NIHR Clinical Research Facility (CRF) and Clinical Trials Unit (CTU) provide support for clinical trials from bid development, to facilities and research staff (£27.5m investment into Research, Innovation, Learning and Development 'RILD' Building; **ILES 4.17**), participant recruitment (e.g., Exeter 10,000 and PROTECT cohorts of research volunteers; **ILES 2.7**) and trial management (e.g., **Dirks's** Wellcome Fellowship, and BBSRC-IPA clinical trial by **Jones and Vanhatalo**).
3. Exeter Sequencing Unit on Streatham campus (with PacBio and Illumina NovaSeq 6000 DNA Sequencing System) and a new Digital Research Storage Management system for high and medium performance computing (ISCA and ISAMBARD), support SHS human microbiome and human genome research and 'big data' storage (**ILES 4.20**).
4. The new VSimulators building (a £4.6m EPSRC-funded facility; **ILES 4.19**), housed at Exeter Science Park, incorporates a six degree of freedom state-of-the-art motion platform (4m x 4m), a fully instrumented floor, multi-user virtual reality capability, and full body motion capture. Funding has recently been secured by **Dixon** (£50k, UKRI) to explore lower limb loading in elderly sportspeople, and **Young & Wilson** (Parkinson's UK, £177k) to investigate 'freezing' in Parkinson's disease in this unique facility.
5. The installation of field-testing facilities (including portable force platforms) at both the Commando Training Centre in Lymington and at the Exeter Chiefs training ground facilitate impact activity by the HMS group in assessing lower limb injury risk in marine recruits and elite rugby players.

3.3 In-kind contributions

Finally, some of the research carried out over the REF period would not have been possible without significant in-kind contributions from funders. The UK Space Agency have estimated that the in-kind contribution to **Etheridge's** work on the *International Space Station* as approximately £4.2m. *Intuitive Surgical* provided a £1.5m Da Vinci surgical robot to the department to support two sequential research grants on training perceptual skills (one to **Vine** and one to **Buckingham**). This was subsequently housed at the **Royal Devon and Exeter NHS Foundation Hospital (RD&E)** hospital, improving their training facilities and helping to leverage further clinical Research Fellow funding to support these research programmes.

4. Collaboration and contribution to the research base, economy and society

4.1 Collaborations

4.1.1 International research collaborations

SHS has a global reputation for collaborative, multidisciplinary, impactful research in human health and sport science. In 2019/20, 70% of our research publications had international co-authors, and unit staff were involved in 65 international collaborations (1.9 per FTE) with 45 different institutions: 30% of these collaborations were with North American, 17% EU, 13% Australian, and 5% with Asian partners. QS World top 100 universities (2021) among SHS's international partners include Harvard University, University of Oxford, Nanyang University of Technology, University of Hong Kong, University of Toronto, UCSD, Chinese University of Hong Kong, Hong Kong University, UBC, UQ, Technical University of Munich, University of Copenhagen, University of Glasgow, University of Illinois, and KU Leuven.

As part of a major University of Exeter global initiative, SHS has spearheaded two **strategic partnerships** with sport and health science departments in the world's top 100 institutions:

1. *University of Queensland (UQ, 3rd for sports related subjects in QS rankings 2020)*: The QUEX Institute, a formal research partnership between University of Exeter and University of Queensland, was launched in 2016. We have been successful in securing 10 joint PhD positions from the QUEX Institute since its inception that align with 'Physical Activity and Nutrition', one of the 3 QUEX research themes. SHS-UQ partnerships have already resulted in 8 joint research outputs and QUEX partners hold an annual QUEX conference to promote PhD and ECR research and provide networking opportunities.
2. *University of British Columbia (UBC, 2nd in QS rankings 2020)*: SHS staff visited UBC in 2018 and 2019, with several mutually complementary collaborations identified among IP, HAL and MHS research groups and UBC colleagues. We are currently formalising a 'virtual institute' with UBC Okanagan (2020) to leverage trans-Atlantic funding opportunities and create a joint PhD programme.

In addition, staff are involved in several **international research partnerships**, the most established of which include:

1. **Etheridge** and **Deane** are members of the *Worms in Space: The Molecular Muscle Experiment*, supported by a total of £2.3m of grant funding, which aims to understand the causes of neuromuscular decline in space with international partners from Greece, Japan, South Korea and the USA. The potential impact of this work for maintaining functional capacity in older age is considerable and anticipated to be a major contributor to SHS research impact in the next REF period.
2. **C. Williams** leads the *Physical activity, exercise, sport and recreation promotion for adolescents with cystic fibrosis (CF)* consortium with the Cystic Fibrosis Trust and co-leads from UCL, La Trobe University (CAN), and Swansea University. The project brings together exercise specialists, psychologists, physiotherapists, engineers, clinicians, parents and adolescents to prescribe physical activity for young people with CF, and aims to establish the world's leading advisory group on physical activity promotion in CF.
3. **Pulsford** is a member of the *ProPASS* consortium, an ambitious international project with collaborators from 17 institutions across 8 countries, which is working to harmonise physical activity demographic, environmental and health data from large cohort studies from around the world to impact on national and international physical activity guidelines and policy.
4. BBSRC awarded **Jones**, **Vanhatalo** and **Wylie** a US Partnering Award (2019) to develop a skill transfer platform and a sustainable collaboration between SHS and the US National Institutes of Health (NIH) with Prof Schechter (Chief of the NIH Molecular Medicine Branch NIDDK, Bethesda MD, US). In 2019, **Wylie** spent two months at the NIH facility to aid the transfer of key skills between laboratories, and the NIH team visited SHS for a partnership launch symposium.

Support for developing international research collaborations is provided by two SHS *Directors of Internationalisation* (**Farris** and **Buckingham**) who manage College-level funding to support the development of international relationships. The SHS drive and vision for global research is exemplified by the appointment of **Bowtell** as CLES Associate Dean for Global, following her work as SHS HoD in developing the UQ and UBC partnerships. Over the REF period SHS staff have been awarded £20.5k in funding via College Outward Mobility Academic Fellowships (OMAFs) to visit our partner institutions and develop research- and teaching-related activities. SHS researchers have also benefitted from £9.5k of College Europe Network Fund (previously EU Facilitation Fund) pump-priming for collaborations with leading European institutions (e.g., VU Brussels, 2017; University of Copenhagen, 2020).

4.1.2 Local research collaborations

As a department of 33.8 FTE within a University of more than 1,200 REF-eligible academic staff, SHS has judiciously added to its research power and capabilities via interdisciplinary collaboration during this REF period. These collaborations include joint PhD supervision and grant awards. CMH and the RD&E hospital are active research partners in clinical trials (HAL and IP groups); projects on mobility, muscle strength, fall risk and prevention (HMS); and oxygen delivery and

nitric oxide homeostasis in conditions such as COPD, diabetes and anemia (IP). The CHERC group has had a long-standing collaboration (15 years) with the RD&E children's ward and its Cystic Fibrosis Centre. The IP group work with Biosciences, LSI and TREE on projects involving metabolomics, microbiology and bioinformatics, especially concerning host-microbiome interactions and the human genome and transcriptomics. SHS biomechanists interact with colleagues with complementary engineering expertise within CEMPS.

SHS has sought **strategic regional collaboration** through the **GW4 Alliance**, a partnership between four research-intensive 'Great West' universities (Exeter, Bath, Bristol, and Cardiff; **ILES 1.8**). For example, **Pulsford's** GW4 project '*Moving Through Motherhood*' develops resources to support physical activity in expectant and new mothers in the community. **Vine** and **Wilson** received GW4 funding to explore the impact of occupational stress in high pressure environments which subsequently informed the Devon and Cornwall Police 2021 Health and Wellbeing Strategy. **Vanhatalo** and **Jones** collaborate with Cardiff University School of Dentistry on dietary manipulation of oral biofilms with joint funding from the BBSRC. Beyond GW4, **Vine** has partnered with academics in Falmouth University for a South West 'immersive business' project as part of £2.05m grant from the *European Regional Development Fund* (Jan 2020), which has led to the creation of an immersive technology facility in Falmouth, which plans to engage 500 businesses in Cornwall over the life of the project.

4.2 Impact and engaged research

A key strength of our research strategy is that we have focused on partnering with industry and charities to co-create research programmes that can impact on society, sporting organisations and business (see *Section 3* for examples). We have enhanced the **support for impact and engaged research** during the assessment period. The SHS Director of Impact coordinates termly departmental impact meetings with presentations from staff on their impact activities so that best practice and potential pitfalls can be shared. Staff also have access to university-wide workshops and training opportunities, support from Impact and Partnership Development Officers, as well as funding (e.g., via ESRC Impact Acceleration Awards, with £12k awarded to SHS in this assessment period). We have held stakeholder events to showcase our impactful research to colleagues in CMH, LSI and the RD&E hospital. All staff are involved in the development of an ICS, based on how their engaged research might be utilised by their private and public sector partners over the next REF period.

Our drive towards **increasing impact generation and engaging non-academic stakeholders** in 2014-2020 has been highly effective, resulting in a wide range of benefits to industry, professional bodies and sporting communities in the UK and globally. Our key non-academic partners and beneficiaries, and some examples of our impact, are highlighted below.

4.2.1. Sport and health nutrition industry

Partners: BeachBody, Beet It Sport and James White Drinks, Cherry Marketing Institute, DuPont, PepsiCo, Pukka Herbs and Quorn.

- ✓ *Impact highlight:* The ergogenic effects of dietary nitrate in endurance (REF2014 ICS) and now also sprint and high-intensity intermittent sports (**REF2021 ICS**) discovered by **Jones**, **Vanhatalo** and **Wylie** has propelled nitrate to be recognised as one of the few evidence-based performance-enhancing nutritional supplements.
- ✓ *Impact development:* The sustainability of impactful nutrition research at SHS is exemplified by continuous development of new ICS beyond 2021, e.g., on the efficacy of mycoprotein as an alternative plant-based and environmentally-friendly protein source to support muscle metabolism and maintenance of muscle mass by **Wall**.

4.2.2. Local and national government bodies

Partners: Active Devon Partnership, Devon and Cornwall Police, Institute of Naval Medicine, Plymouth NHS Trust, RD&E NHS Trust, The Royal Marines and Lympstone Commando Training Centre, and Sport England.

- ✓ *Impact highlight:* **Dixon, Stiles** and **Rice**'s research with the Royal Marines has resulted in changes in standard issue footwear and the introduction of biomechanical screening to reduce injuries, with an estimated £5m of savings to the Ministry of Defence annually.
- ✓ *Impact development:* The **CHERC** team have worked with a network of UK's cardiac centres since 2012 to embed resources on physical activity and exercise recommendations (the Physical Activity Toolkit) for clinicians, patients with congenital heart disease and their families, thus improving knowledge and providing confidence in physical activity participation.

4.2.3. Footwear and sports apparel industry

Partners: Asics Oceania, Brooks, Cosyfeet, New Balance, and Nike.

- ✓ *Impact highlight:* **Jones** acted as chief external scientific advisor to Nike's 'Breaking 2' project, supplying some of the scientific research and insight which ultimately underpinned the achievement of the first sub 2-hour marathon by Eliud Kipchoge in 2019 (**REF2021 ICS**).
- ✓ *Impact development:* The SHS biomechanics team (**Dixon, Farris, Rice**) are active in several projects directly informing footwear design in terms of comfort and safety (Asics, Cosyfeet, New Balance), and the minimising of tibial stress (Brooks), and **Jones** and **Vanhatalo** have worked with Nike to explore the influence of new generation footwear on running economy.

4.2.4. Technology

Partners: Activeinsights, Cineon Training, Factory 42, Hikma Pharmaceuticals, Natural History Museum, and Sellafield Ltd.

- ✓ *Impact highlight:* Eye-tracking research by **Vine** and **Wilson** resulted in the development of quiet eye training resources for performance under pressure and the creation of start-up company, Cineon Training (**REF2021 ICS**). The company has now developed virtual training tools for a variety of safety-critical industries across the world (military, nuclear, oil, pharmaceuticals) and is involved in other virtual experience projects (e.g., 'Audiences of the Future' with Factory 42).
- ✓ *Impact development:* During the Covid-19 pandemic, Cineon Training (with **Vine & Wilson**) delivered virtual training materials to frontline NHS staff on personal protective equipment use (accessed by 500 staff in April 2020 alone). A Virtual Reality training tool for patients who are anxious about MRI scanning was also developed for the Plymouth Hospitals NHS Trust (2020), and is currently being marketed to other NHS trusts, and via a private health company (In Health Group).

4.2.5. Sports community

Partners: Locally: Exeter Chiefs Rugby Club, Exeter City Football Club; Nationally: British Cycling, British Gymnastics, England Athletics, the Football Association, GB Pentathlon, Lawn Tennis Association, Manchester United FC (MUFC), Welsh Rugby Union; Globally: Australian Institute of Sport, Canadian Sport Institute, International Olympic Committee, NN Running Team, UEFA.

- ✓ *Impact highlight:* Research led by **Dixon** at the Exeter Chiefs Rugby Club has led to important advances in lower limb injury prediction and prevention. Two match-funded PhD studentships and a Knowledge Transfer Partnership (2018) with the Chiefs has established on-going systematic injury monitoring at the club.
- ✓ *Impact development:* There are numerous examples of SHS research impact on professional and international sport teams and athletes, some of which feature in our ICS for REF2021. The **CHERC** group has a long-standing collaboration with MUFC youth academy and a new venture from 2020 funded by England Athletics 'Youth Talent Program' to support athlete development, which are anticipated to generate significant impact during the next REF period.

4.2.6. Charities, societies and agencies

Partners: Cancer Research UK, Cystic Fibrosis Trust, Diabetes UK, Dunhill Medical Trust, Exeter Leukaemia Fund, International Space Station, Natural History and Science Museum, Northcott Devon Medical Foundation, Royal Osteoporosis Society, The Waterloo Foundation, UK Space Agency.

- ✓ *Impact highlight:* Development of physical activity and exercise guidelines for children and young people with cystic fibrosis (**Barker, C Williams**).
- ✓ *Impact development:* **Etheridge's** research that aims to prevent muscle loss in space through discovery of new genetic and transcriptomic biomarkers and development of novel interventions involves spaceflight of tiny *c. Elegans* worms to the International Space Station. The 'Worms in Space' project is generating considerable public engagement and informing new experiments selected for upcoming space missions.

4.3 Key contributions to the public sector and society by SHS researchers during the assessment period include:

1. **Hillsdon** and **Pulsford** were members of the UK *Chief Medical Officers' Physical Activity Expert Group* (2018). **Pulsford** was a co-author on the final government report which forms the basis of the current national physical activity and public health strategy.
2. **Pulsford** was a member of the Expert Advisory Group for *Public Health England's* 'Moving Medicine initiative' (2019), and was also part of a rapid review team convened by the UK Chief Medical Officers to review public facing public health information regarding physical activity during Covid-19 lockdown periods.
3. **Hillsdon** has been recently appointed to the *Versus Arthritis* physical activity expert group to help develop a new campaign to promote an active lifestyle in people with arthritis.
4. **C. Williams** was a member of the *UK Chief Medical Officer Expert Group* in 2018 to revise physical activity guidelines for young people (5-18 years old). He was also invited to provide expert opinion on *EU Reviews of Scientific Evidence and Policies on Nutrition and Physical Activity* in 2017 on behalf of the *International Classification of Functioning, Disability and Health (ICF)* and *European Centre for Social Welfare Policy and Research*.
5. Training resources developed by **Vine** and **Wilson** have been embedded within national guidelines for *elite military forces* and *urology surgeons*. Their partnership in developing virtual reality training solutions with Dstl was outlined as a case study in the government's UK Research & Development Roadmap (July 2020).

4.4 Contributions to the discipline

SHS staff have contributed significantly to the wider development of the sport, exercise and health sciences both nationally and internationally. Our academics have given more than 250 keynotes and invited lectures on six continents during the REF period, and organised or chaired 21 symposia, conferences and workshops.

4.4.1 Awards, honours and Fellowships

During the assessment period researchers within SHS won 24 awards and honours. The majority of these (18) were PhD and early career prizes. Our PhD students won the **BASES Prof Tom Reilly Doctoral Dissertation of the Year** three times (Bond 2015, Tomlinson 2019, Morgan 2020), and the high calibre of Exeter's nutrition research has been recognised by two **ECSS Gatorade Sport Science Institute Sport Nutrition Young Investigator Awards** (McDonagh 2015, Montayne 2019). Other highlights include two ECSS Young Investigator Awards (**Dirks, Vlachopoulos**), and a Bone Research Society New Investigator Award and Neil Mackenzie Public Engagement Award (**Vlachopoulos**). Our senior academics have been awarded **Fellowships of the Physiological Society** (**Jones, Stephens**) and **ACSM** (**Vanhatalo**). Jones was awarded the **ACSM Citation Award** in 2020 in recognition of his outstanding contributions to sport medicine and

the exercise sciences. He is the 13th most cited author of all-time within sport science/physiology (Mendeley).

4.4.2 Professional societies and qualifications

In addition to eight Fellowships (3 ACSM, 2 BASES, 1 ECSS, 2 Phys Soc) our staff are professional members of 15 societies and professional bodies. **Byrne** is a HCPC Registered Physiotherapist of the Chartered Society of Physiotherapy; **Wilson** is a HCPC Registered Sport and Exercise Psychologist, and along with **Harris**, **Vine** and **Young**, also a Chartered Psychologist with the British Psychological Society; and **Torquati** and **Revuelta Iniesta** are Registered Nutritionists (Association for Nutrition, UK) and **Revuelta Iniesta** is a Registered Dietician (Health and Care Professional Council, UK).

4.4.3 Editorial work

SHS members have had significant editorial roles at leading journals including: **Editor-in-Chief** of the ECSS society journal, the *European Journal of Sport Science* (**Jones**). Staff have also held **Associate Editorships in 21 journals** (e.g., *British Journal of Sports Medicine*; *European Journal of Applied Physiology*; *Exercise and Sport Sciences Reviews*; *Journal of Sport and Exercise Psychology*; *Medicine & Science in Sports & Exercise*; *Psychology of Sport and Exercise*; *Sport, Exercise and Performance Psychology*), and served on the **editorial boards** of 17 other international journals. **Wilson** was guest editor for two volumes of *Progress in Brain Research* (2017).

4.4.4 Advisory boards and review panels

SHS researchers benefit society and industry through membership of several expert panels, e.g., the Scientific Advisory Boards of; AMPHuman (**Jones**); the Gatorade Sports Science Institute Expert Panel (**Jones** and **Bowtell**); Nike Inc. (**Jones**); Pediatric Work Physiology Scientific Board (**C. Williams**); the Royal Osteoporosis Society Expert Group (**Vlachopoulos**); the UK Space Agency 'Space Environments Advisory Committee and the European Space Agency (**Etheridge**). Staff have also served on research review panels, including the Croatian government Review Panel of national Kinesiology PhD programmes (**Bowtell**, Co-Chair), the Medicine, Health Sciences and Biology grants panel for the Research Council of Norway (**Jones**), and the ESRC Peer Review College (**Wilson**). **Jones** was a REF panel member in 2014 and is the deputy chair for UoA24 in REF2021.

Summary: SHS is a powerhouse of research intensity with global impact. Our growth in research power stems from agile and responsive industry relations and long-term investment in our people. Our future success will be built on a diverse funding portfolio and multidisciplinary engaged research, with impact generation intrinsically embedded in our culture.