Institution:
Cardiff Metropolitan University

Unit of Assessment:
UOA24: Sport and Exercise Sciences, Leisure and Tourism

1. Unit context and structure, research and impact strategy

Cardiff Metropolitan University School of Sport [1] has achieved significant growth across a number of key performance indicators during the current REF census period, including a **225**% increase in the number of staff being returned, a **154**% increase in research funding, a **988**% increase in external PhD studentship funding, and an **88**% increase in PGR completions. Internal University and School funding to support staff and student research-related activities amounted to **£2.7 million** across the assessment period contributing to **14** staff PhD completions, **47** research prizes and short-listings, and collaborations spanning **75** countries. Staff held **55** Editorial Board and Guest Journal Editorships across **48** journals during the period.

Context, Structure and Strategy

In 2014, predicated on 20 years of collaboration and HEFCW's strategic research imperatives, Cardiff School of Sport at Cardiff Met and the School of Sport, Health and Exercise Sciences at Bangor University made a joint submission to UoA26 under the auspices of the Institute for Research Excellence in Sport and Exercise (IRESE). The research environment was rated 75% 4* and 25% 3*. The REF2014 IRESE strategic priorities were to: (a) consolidate and extend the well-established research links between the two universities; (b) establish a structure that assures recognition for high-quality research; (c) develop robust and sustainable mechanisms to encourage and support research; (d) increase grant capture for research initiatives that produce high-quality outputs; and (e) continue to exploit the impact of IRESE research beyond academia.

The close working relationship with Bangor has continued during this census period, with collaborative initiatives aligned to these strategic priorities including: three jointly funded and supervised PhD studentships; nine cross-institutional PhD student supervisions; six successful grant applications (**circa £150k**); over **20 jointly authored publications**; and, reciprocal input into respective School research seminars. The jointly funded Cardiff Met-Bangor PhD studentships resulted in two international scientific expeditions to Nepal and Peru to better understand altitude-related health. These expeditions, which involved researchers from three continents and had Global reach, resulted in three successful collaborative funding applications, and **19 published** outputs by members of IRESE. In addition, the £600k UK Sport funded Great British Medallists project provided a catalyst for collaboration on the UK Sport funded Performance to Podium and the English Institute of Sport and British Triathlon Federation funded Triathlon Mindset projects. However, arguably the most notable Cardiff Met-Bangor collaboration was the awarding of the prestigious **ESRC Doctoral Training Partnership pathway in Sport and Exercise Sciences** in 2016 (also including Swansea University), one of only two such pathways in the UK. To date, the pathway has been awarded **13 ESRC** doctoral studentships, with Cardiff Met and Bangor securing 10 of these (5 each), at an estimated value of **£680k**. Part of the ESRC DTP pathway, the annual **pan-Wales PGR** Sport and Exercise Sciences Student Conference has attracted over **200 PGR** students from the partner institutions (Cardiff Met, Bangor, Swansea and South Wales Universities).

Despite the ongoing success of the collaboration, both Institutions resolved that they would make separate submissions to UoA24 for REF2021. This decision was based on several strategic, logistical, financial and reputational factors. For example, the necessity to return all individuals with a 'significant responsibility for research' made a joint submission of two

[1] In 2017 the School of Sport merged with the School of Health Sciences to form Cardiff School of Sport & Health Sciences (CSSHS). Where the narrative refers to the merged School it will be denoted by CSSHS. School in isolation is used to denote the original School of Sport for the whole census period through to July 2020.

departments with different size (16.8 FTE vs 42.2 FTE) and academic role profiles incompatible in terms of modelling the highest quality return. Financial imperatives, QR funding formulae, regional strategic priorities and the desire to better evidence individual institutional growth and evolved research emphases were also factored into the decision.

The School's strategic research priorities for this census period, which aligned with those of IRESE, centred on 'enhancement'. Specifically, (a) increased volume and quality of research by fostering an inclusive and sustainable research culture; (b) growth and diversification of research and innovation income; and (c) increased research impact. The key performance indicators of success against these three strategic priorities are as follows:

(a) Increased volume and quality of research

A **225% increase** in the number of staff being returned to REF2021 (an increase from 13 to 42.2 FTEs) is testament to the growth in our output volume and quality during the census period. The increased volume is also reflected in the number of School outputs uploaded to the University's open access repository (D space) since January 2014 (n=663), compared to the previous census period (n=305). Indeed, the growth in the volume and quality of research from School staff was integral to Cardiff Met being listed in the THE World University Rankings for the first time in 2019 and again in 2020 (with the School contributing over a third of the total publications across the University). In 2020 we also had our inaugural listing in the THE World University Young Rankings. Our research quality is also evidenced by its impact across a range of stakeholder and end-user groups (discussed below and throughout this environment statement).

(b) Growth and diversification of research and innovation income

The School has achieved significant growth and diversification in external funding sources since REF2014. During the census period, HESA-defined research income has grown **154%** (£287,476 to £729,043) from a variety of public (e.g., NHS, English Institute of Sport, Sport Wales, South Wales and Gwent Police forces) and private (e.g., World Rugby, FIFA, Welsh Rugby Union) sector organisations. PhD studentship income has grown **988%** (from £32,103 in 2014 to **£349,351** in 2020). This includes **5 ESRC** studentships, **14 Knowledge Economy Skills Scholarships** (KESS-2), and **3 *Coleg Cymraeg Cenedlaethol*** studentships.

(c) Increased research impact

In line with Cardiff Met's R&I strategy, impact is integral to our research activity. Building on our REF2014 return (Impact rating 66% 4*, 33% 3*), the four Impact Case Studies (ICS) that comprise this submission and emanate from five of our most established research groups (Physiology of Health and Sport; Youth Physical Development; Sport Injury and Medicine; Biomechanics; and, Sports Coaching and Physical Education) are testimony to the success of our strategy to support and nurture high quality impactful research across a breadth of research foci. The four ICS were selected from over 10 impactful programmes of research from seven different research groups within the School.

Mechanisms for achieving strategic research priorities

Research Groups have provided the conduit for all research activity in the School. For the majority of the census period nine cognate groups, led and supported by Professors, reflected the areas of existing research foci and strength, critical mass and emerging areas of research within the School: Physiology of Health and Sport; Youth Physical Development; Sport Injury and Medicine; Sport and Exercise Psychology; Biomechanics; Socio-cultural; Sports Coaching and Physical Education; Performance Analysis; and, Sport Management and Development. Under the leadership of the School's Associate Dean for Research, these Research Groups have been a catalyst for operationalising the School's strategic priorities.

A number of University and School initiatives supported the attainment of our strategic priorities. At Institutional level these included competitive internal funding schemes such as the Research Innovation Awards (RIA) and the Research, Enterprise and Innovation Fund (REIF), which were predicated on nurturing research with 4* potential for quality and impact, and enhancing external grant capture - through funded PhD studentships, research assistantships and external collaborations. The Get Started scheme provided seed funding to stimulate growth in new research and innovation activities. During the census period the School secured over **£330,000** in internal competitive funding through these schemes, including: three interdisciplinary programmes of PhD research (e.g., a fully funded PhD studentship led by **Gittoes,** which examined the relationship between psychosocial factors and physiological stress-related markers in injury occurrence); three programmes of research that form the basis of ICS led by **Drane**, **Moore, Lloyd** and **Oliver** that are part of this submission; and a further three programmes of research with potential to form the basis of future ICS (e.g., a multi-centred, multidisciplinary clinical trial into the effects of high-intensity interval training [HIIT] versus moderate-intensity steady-state [MISS] exercise in cardiac rehabilitation in NHS settings; **Lord**). Six outputs externally rated as potentially 4* and being returned as part of this submission have also directly resulted from these centrally funded initiatives, as have eight applications for external research funding.

Institutional funding has been complemented by School funding initiatives targeted at growth and diversification in the volume, quality, financial sustainability and impact of our research. These include funding of full and part-time PhD studentships; research assistant hours to support research-related activities; writing awards to relieve staff workload for an extended period of time; and two-year post-doctoral fellowships. Other funding initiatives include support for staff PhD completion; PhD candidature awards to provide additional support following the conclusion of existing funding arrangements; a PhD publication output fund to provide support during publication of thesis outputs; and a seed-corn scheme to pump prime research with potential for external grant capture. Thus, internal funding from the School to support our strategic priorities was significant (**£1,714,675m**). Additional support in the form of bespoke School staff development workshops, a research seminar series, termly research fora, funding for conference attendance and research mentoring have supplemented the Institutional programme of staff development initiatives that target the specific needs of staff and research groups to enhance research quality and impact.

A number of other activities have been integral to fostering impact in our research. The School Impact Working Group led by our REF Co-ordinator is key to helping foster and support programmes of impactful research and the development of the ICS that form part of this submission. Quarterly group meetings supplement individual impact support meetings. Early in the REF cycle external input into our impact strategy and the quality of 10 ICS was provided by a previous REF panel member. Three central institutional assessments of the development and quality of the ICS and multiple ‘away days’ provided further catalysts for the ongoing development and selection of the case studies for this REF.

By way of illustration of the breadth of our impactful programmes of research, including those being returned for this REF, the head injury prevention and management in cricket and rugby union ICS led by **Moore** (Sport Injury and Medicine group) shows how research informed policy and practice resulting in a new British Standard for Head Protectors in Cricket (BS7928:2013), and a national concussion education programme in Welsh rugby union. The Youth Physical Development group ICS led by **Lloyd** and **Oliver** shows how research into the long-term athletic development of children and adolescents has informed guidelines on youth resistance training and long-term athlete development - including the American College of Sports Medicine’s Youth Fitness Specialist certification programme. Meanwhile, the International Primate Heart Project (IPHP) led by **Drane** (Physiology of Health and Sport group) demonstrates the impact of cardiovascular research in humans on critically endangered species of great apes; informing the largest ever re-introduction programme of chimpanzees back into the wild. Finally, the coach education and professional practice ICS (led by **Jones** and **Irwin** - Sports Coaching and Sports Biomechanics groups) evidences how research has shaped the practice of sports coaches and

scientists both internationally and in the UK. A further ICS supported within the School led by **Bolton** (Sport Development and Management group) is being returned to UoA17 Business and Management Studies and Aldous is part of an education ICS being returned to UoA23. Other developing ICS include: psychosocial factors in talent development and world-class performance (**Evans;** Sport Psychology); the development of physical literacy in schools (**Morgan;** Sports Coaching and Physical Education); and, physical activity, psychological wellbeing and presentism within the police force (**Thomas**; Sport Psychology).

Alongside impact, interdisciplinarity has been integral to several initiatives over the current REF cycle. Indeed, it has been central to the University (e.g., Research Innovation Awards) and School (e.g., PhD studentships) funding calls and multi-day researcher-led sandpits to develop interdisciplinary research partnerships and research plans, which our staff have engaged with. Interdisciplinarity was also integral to the awarding of the **ESRC Wales DTP pathway in Sport and Exercise Sciences** (SES) and has been evidenced by a number of outputs being returned by staff to UoA24 as part of the current submission. It was also a key driver for the launch of the Centre for Health, Activity and Wellbeing Research (CAWR) in 2019, a conduit to respond to current and future imperatives around public health and wellbeing. Drawing expertise from across the sport and health sectors, CAWR seeks to address Welsh and UK Government strategic priorities and United Nations Sustainability Development Goals (2013) around health and wellbeing, economic growth and fostering sustainable communities. **Crone's** appointment to lead CAWR will enable us to capitalise on our breadth of research expertise to employ interdisciplinary approaches to address some of the major societal issues within the changing research landscape.

Open Access

Following the introduction of the University's Open Access policy in 2014, considerable progress towards an open access research environment has been achieved over the census period. Our researchers work closely with the University's Library Services following a schemed workflow to ensure outputs (and other research resources) are uploaded to the institution's open access repository (DSpace) in line with the REF open access policy. In 2018, the University invested in FigShare to support our drive towards a more open research environment and go beyond current REF open access policy requirements. Importantly, FigShare provides a more effective platform for the sharing of research data and associated outputs whilst facilitating impact via research and general population user engagement. For example, **Moore's** recent BASES funded interdisciplinary project examining gait and physiological characteristics provides access to a range of materials used in the research (including raw data and computer software macros) that were developed to allow lay individuals to perform research-level analysis to inform sports performance. Furthermore, recent directives from The Physiological Society and the American Physiological Society require the presentation of individual data wherever possible, adequate description of methodologies to allow for reproducibility, and the publishing of raw data in an online repository (e.g., FigShare).

Research Integrity

All research undertaken within the School is subject to the scrutiny and standards of the School Research Ethics Committee (SREC), which reports to the University Ethics Committee and operates in accordance with the University's Ethics Framework. The SREC contains six subpanels (natural sciences, social sciences, biomedical sciences, psychology, health care, and food and applied community sciences), which meet on a fortnightly basis and report quarterly to SREC. Ethical queries can also be referred to the University Ethics Committee where necessary. Professional development sessions on the University and School's ethics frameworks and governance are held regularly. A Designated Individual for the Human Tissue Act sits on the School's Research Ethics Committee and Persons Designated are members of the subpanels to ensure compliance with the University's license to conduct work involving the procurement, storage, handling, transfer, transportation and disposal of human derived materials. Adherence to accrediting body ethical codes of conduct for programme and staff accreditations also

features within our research integrity practices and culture. Examples include British Association of Sport Rehabilitators and Trainers, British Association of Sport and Exercise Sciences, British Psychological Society, Broadcast Journalism Training Council, Chartered Institute for the Management of Sport and Physical Activity and National Strength and Conditioning Association.

Future Strategic Aims

Over the next five years, we will continue to build on the growth seen during the current REF period in research quality and impact; the diversification of research income to safeguard the sustainability of high quality research and research culture; and, the preponderance of multi and interdisciplinary research that addresses priority research needs across sport, health and wider societal agendas. We will also continue to build on existing pan-Wales collaborations within, and beyond the ESRC DTP in SES. Over the next REF cycle and aligned to the University's 5-year strategic plan (2018-23) and specific University and School measures of success, our objectives include:

(a) growth in research funding, in particular from cherished and charitable funding sources;
(b) enhancing the quality of our research outputs and impact through ongoing strategic School initiatives, such as research mentoring;
(c) increasing the number of staff with significant responsibility for research through formal mentoring and ECR schemes and programmes;
(d) enhancing international R&I partnerships through targeted support of programmes of research that have global reach;
(e) fostering new areas of interdisciplinary research by harnessing the strengths of our reconfigured research group structure.

A key mechanism for achieving these strategic priorities will be the recently formed Global Academy for Health and Human Performance, one of three University level Global Academies which bring together strengths in research and innovation to address challenging global priorities. The Global Academy combines expertise and knowledge found within the CAWR, the recently reformed CSSHS Research Groups and the strengthening infrastructure that exists within the School.

2. People

Staffing Strategy and Staff Development

The School's strategic priorities for this census period are epitomised by its commitment to research excellence through the appointment, support and development of high-quality staff. This is evidenced by the: (a) targeted recruitment of well-established, internationally recognised scholars with a record of research leadership, grant capture and impact (e.g., **Crone**, **Mellalieu**); (b) planned and targeted investment in early career, emerging and established researchers who show the potential to produce 3 and 4* quality research (**Corsby, Drane, Jennings, Lord, Moll, Moore, Pugh, Stembridge, Stöhr**) and impact (**Drane**, **Lloyd**, **Lord**, **Moore**, **Oliver, Stöhr**); (c) internal promotion to Reader (**Bezodis, Gittoes, Lloyd, Moore, Oliver, Stembridge)** and Professor (**Cooper, Evans, Jones C, Oliver**) for applicants who meet the criteria; and, (d) engagement of eminent researchers to advisory roles and as Emeritus Professors (**Hardy**, **Kerwin**, **Maddison**), Visiting Professors (**Ackerman, Cockcroft, Speed, Nokes**) and Visiting Readers (**Backx, Yousef, Zouwail**).

Throughout the census period the School adopted several mechanisms to help staff realise their aspirations and potential for delivering high quality impactful research. The performance and development review scheme, which involves three annual staff review meetings, acts as an important mechanism to ensure staff research goals and activities are aspirational and strategically aligned. It also acts as a conduit for the allocation of protected research time, which research active staff receive over and above the research and scholarly activity time allocated to all staff. The amount of allocated research time is based on actual - or in the case of new and

emerging staff, potential - research productivity, quality and impact. Where staff are part-time or fractional the allocation is *pro rata*. All staff also have access to a research mentor, a senior researcher in the School, who provides guidance and support for their professional development. The success of this scheme and its effectiveness in providing support for talented researchers at different stages of their career is best evidenced during this census period by **Drane's** progression from Research Assistant to Lecturer; **Stembridge's** progression from Research Fellow to Lecturer, Senior Lecturer and Reader; **Moore's** progression from Research Assistant to Lecturer and Reader; **Lloyd's** progression from Lecturer to Senior Lecturer and Reader; and **Oliver's** progression from Senior Lecturer to Reader and Professor. Significantly, **Drane**, **Moore,** and **Lloyd** and **Oliver** also lead three of the four ICS being returned as part of this submission.

As part of its commitment to supporting research excellence among early career (ECR), emerging and established researchers, the School retained the services of six external world-leading researchers and subject experts, including five previous REF panel members, and invited all staff to have a paper of minimally 2* quality externally rated by them. Each member of staff received individual feedback, while research groups were given group feedback. This process of external review, which was intended to enhance staff understanding of research quality and the process of achieving it, complemented a process of internal scrutiny and output rating by an internal School panel of senior researchers. It also supplemented external input into the School's impact strategy outlined in the previous section.

Other approaches employed to foster an inclusive, vibrant and supportive research culture that facilitates research excellence included: the School research seminar series, which involved internal and external speakers (including PhD students in joint presentations with supervisory team members); weekly journal clubs; and, research group meetings dedicated to the discussion of research ideas and proposals, grant activity, and impact. Other initiatives to specifically support ECRs include, the ECR forum, which supports staff in the formulation of personal research development plans through action learning sets (which **Moore** co-leads) and PGR supervisory teams comprising ECRs alongside a senior, established researcher. This approach to the composition of supervisory teams, which is integral to increasing high quality supervisory capacity, was successfully employed for the **five ESRC DTP PhD** studentships we secured.

As highlighted in the previous section, the University and School also offered a suite of internal funding initiatives that provided support for ECRs and more established researchers, each with specific steers aligned to our strategic priorities. They included evidence of potential for 3 and 4* research and impact, external grant capture, and interdisciplinarity. These initiatives provided staff with a number of funding opportunities including PhD studentships (£197,767), research assistant support (£14,483), workload relief for specific research objectives (£69,014), and seed funding for early research project ideas (£8,666). All staff also had access to a staff development fund (total spend **£254,585**), which supports for example, conference attendance, upskilling, and maintenance of professional qualifications (e.g., British Society of Echocardiography accreditation). The internal funding initiatives have contributed to **22** staff submitting successful grant applications.

The School has a policy of match-funding externally part-funded funded studentships. We have secured 13 such studentships worth **£748,871** in external funding, providing **£379,194** in match-funding. Such support has been integral to safeguarding the quality and sustainability of the research activity in the School as well as the vitality of our research culture. Other support for staff research activity has been provided through a centralised programme of staff development which includes: training and assistance in writing grant bids; regular updating on funding opportunities including visits from research councils and other funding agencies; writing retreats for PGR students and staff; interdisciplinary 'sandpits' to foster internal and external research collaboration; developing impact; supervisory training; and, doctoral examination and Chair's training.

Staff within the School have also benefitted from a number of external schemes that support ECRs and talented researchers. For example, **Moore** and Aldous were supported through the highly competitive Times Higher Education award-winning Welsh Crucible programme (contention rate 5:1); a package of personal, professional and leadership related courses designed to support early to mid-career researchers. In addition, **29** staff have benefitted from School financial support (e.g., fee waivers) and workload relief (e.g., an additional 271 protected hours annually) to undertake an MPhil or PhD, or professional or taught doctorate. This has contributed to **14** staff PhD completions during the period at a cost to the School of circa **£1,018,898m**. Staff have also been supported financially to enable them to undertake and participate in a wide range of international research projects and collaborative initiatives. For example, four staff were supported to conduct five large-scale scientific expeditions on three different continents and a further five staff were supported to participate in international field trips and dissemination events in Africa and Indonesia. The total value of University and School funding to support staff across the assessment period was **£2,745,940m**.

PGR Students

Considered the research lifeblood of the School, PGR students are integral to our research strategy and culture - thus our strategic focus on studentship funding. Most School PGR students are based in a dedicated research building (Research House) on the Cyncoed Campus, where they have a fully equipped and dedicated workspace. The hub of PGR activity, it provides a supportive, vibrant environment where students can interact for an enriched, shared research experience. The School's Graduate Studies Coordinator is also based in Research House to provide readily accessible formal and informal pastoral support and advice – support that is complemented by two PGR mentors (1 male and 1 female) who sit outside of the supervisory team to provide additional pastoral support. At the time of writing the School has **105 PGR** students enrolled on research degrees (66 male, 39 female, 7 BAME, 73 PT, 32 FT), a **54%** increase from 2014 (n=68); a studentship demographic that is reflective of our commitment to equality and diversity. During this census period PGR completions have almost doubled from 26 to **49** (see Table 1 for Panel C required disaggregated breakdown). This increase in PGR students and completions is consistent with, and evidence of, the realisation of our strategic priority to foster a sustainable research culture through increased and diversified studentship funding sources.

Table 1.
PhD, Professional Doctorates for period 2014-2020

Year	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
PhDs	7	3	10	4	10	7	6
Prof Doc			1			1	

During this REF period the University invested in PhD Manager, a bespoke online system for the support and monitoring of PGR students. This purpose-built system is used as an interface between students and their supervisory teams and covers all post-enrolment milestones (e.g., research degree proposal, transfer from MPhil to PhD), review and monitoring practices (e.g., annual monitoring reports, research training reviews, requests for change to supervisory teams) and examination processes (e.g., thesis submission, approval of examination teams, submission of examination reports). Meanwhile the recent launch of a University Doctoral Academy, a 'one-stop-shop' for all PGR related information, resources and online training/events, provides a central hub for all PGR activities moving forward. During this census period we also became a full member of the UK Council for Graduate Educators and invested in the VITAE network.

At the start of their studies, all PGR students complete an induction programme and attend a centrally organised Research Skills week. This programme is supplemented by ongoing training offerings to support the research skills and professional development of PGRs and includes evening sessions to cater for part-time provision. To safeguard the quality of supervision, researchers who embark on research degree supervision for the first time complete an induction

programme before being eligible to join supervisory teams. Consistent with established good practice across the sector and the QAA Code of Practice, staff new to PhD supervision join supervisory teams with at least one other experienced supervisor to maximise mentorship opportunities. At present, **56** members of staff in the School are engaged in PGR supervision, compared to 35 in 2014.

We consider the personal and professional development of our PGR students as vital and integral to our commitment to foster research excellence. Several formal and informal School mechanisms exist to support and safeguard this in addition to those already mentioned. Formal interactions between PGR students and established researchers are facilitated by the activities outlined in the Staff section above (e.g., research seminar series, journal clubs, and research group meetings). In addition, the annual **University PGR Poster Presentation**, **School PGR Student Conference** and **Pan-Wales PGR Sport and Exercise Sciences Conference** provide students with opportunities to present their research, interact with other students in a supportive conference environment, and network. They also facilitate the cross-fertilisation of ideas within and across disciplines and universities. Since its inception in 2016, the 2-day annual pan-Wales conference has provided additional research training opportunities through presentations by senior researchers both from and external to the constituent universities (Cardiff Met, Bangor, Swansea and South Wales) on cutting-edge research developments and topics of methodological and broader interest. Students are also supported in chairing sessions and introducing speakers. All students are encouraged to avail themselves of these opportunities with all costs met by the organising partners and in the case of the pan-Wales conference, part-funded by the ESRC Wales DTP. The School also fully funds all students to attend and present their research at one national and one international conference during their candidature. **35** students have received School conference funding across this census period at a total cost of **£61,866**. Other School funded activities include students undertaking placements, travelling internationally for data collection and networking, and support for additional research training experiences beyond those directly associated with their own PGR studies. These are initially identified in their Research Training Review, which is part of their enrolment, as well as in their Annual Monitoring Report. The School makes every effort to meet students' bespoke training needs. For example, **Drane's** cardiovascular research on critically endangered species of great apes involved data collection field trips to sanctuaries and zoos in **Africa** (Cameroon, Zambia, Sierra Leone and Republic of Congo), **Indonesia**, **Europe** (Spain, Netherlands and Germany) and the UK. A number of other PGR students (**Curry**, **Dawkins**) and staff (**Lord**, **Shave**, **Stembridge**, **Stöhr**, **Pugh**) were supported to participate in these field trips and were thus afforded exceptional value-added research training and professional development experiences. Finally, the **ESRC's** recent approval of the **MRes in Sport and Exercise Social Sciences** (led by **Cooper**) as meeting the ESRC's 1+3 doctoral research training requirements for ESRC funded students provides PGR students with access to additional research training opportunities.

Equality and Diversity

Consistent with its position as a values-based University, Cardiff Met is committed to all aspects of equality, diversity and social inclusion. This commitment was recognised in 2019 through our inclusion in Stonewall's Top 100 Employers list and the awards of Institutional Bronze Athena-SWAN Equality Challenge Unit charter marks in 2016 and 2020. The School's Dean (**Thirlaway**) is Chair of the Institutional Athena-SWAN Self-assessment Team. In September 2020, the School achieved the University's first departmental Silver award for the period 2015/16 to 2018/19, building on the Bronze it secured in 2017. Significantly, the School Athena-SWAN group is led by a senior researcher (**Gittoes**), with other key members of the group being senior researchers and research leaders within the School (e.g., **Brown, Mellalieu, Moore, Stembridge**), as well as ECRs (e.g., **Lord**, **Pinder**). Advance HE identified the School's Athena-SWAN Silver application as exemplary and an example of best practice in the area of flexible working and shared parental leave. The positive impact of the School's work was also highlighted in the recent Athena-SWAN (Sport) First Lockdown Survey, resulting in Advance HE recommending it as an example of best practice (for March to September 2020).

Cardiff Met's Recruitment and Selection Guidelines mandate a systematic approach to ensure all staff are selected solely on merit with discrimination on the grounds of any protected characteristics explicitly forbidden, including pay, career progression and promotion. The University and School have been committed to identifying equality and diversity (E&D) issues and in instigating a range of measures to promote equality of opportunity and diversity. These include implementing policy change relating to the mandatory scheduling of all committee meetings within core working hours (10am-3pm). The School was pivotal to the University policy change to offer equal benefits to all parents taking maternity, shared parental and adoption leave. We were also pioneering in covering maternity leave with a fixed-term contract that extends beyond the period of leave to mitigate the motherhood penalty associated with research activities. During the reporting period, 13 academic staff took maternity and 6 paternity leave – with one researcher taking an extended one-year paternity leave.

The School has also worked to improve perceptions of, and practices related to flexible and fractional working and career breaks. Our Flexible Working Scheme allows staff to request a temporary (usually a maximum of two years) move to flexible, fractional work. Since 2015, flexible working uptake has increased from 1 to 10 staff, which includes two senior researchers (**Gittoes** [F], **Mellalieu** [M]) currently working temporary fractional 0.7 and 0.5FTE contracts respectively. One female academic also took a non-parental leave career break during the reporting period.

Other enhanced E&D practices we have supported include the *Women to Professor* Action Learning Set series, to which several Professors in the School contribute (e.g., **Cooper**, **Crone, Evans**). Led by the University Director of Research and PVC R&I, and with input from the VC, this pioneering series outlines the routes and requirements for promotion and empowers attendees to shape their performance-related objectives and associated working practices. Eight female School staff (**Dohme**, **Drane**, **Gittoes, Howells**, **Lord, Moore, Robinson, Thirlaway**) have attended the programme in the last two years, with one (**Moore**) having already successfully progressed to Reader.

The proportion of females included in this submission (38%) aligns with the School's proportion of female academics during the early portion of the cycle (average of 36% from 2013-2019) but is slightly below the current proportion (41%). Females currently occupy 34% of eligible returnees, 31% of senior researchers and 33% of Professor roles in the School. The School recognises the continued low representation in our submission from other protected characteristics such as BAME, as well as the need to continue to promote E&D in its policies, practices and research culture. An ambitious five-year E&D action plan that formed part of the successful Athena-SWAN Silver award will provide the basis for further addressing School E&D policy and practices moving forward. In addition, Cardiff Met has established a Race Equality Charter stakeholder working group, as part of its drive to achieve an Advance HE Race Equality Charter by 2024. The University also aims to achieve an Institutional Silver Athena-SWAN award. The School will contribute to both these goals through a series of strategic initiatives ensuring that our Directorate and senior researchers reflect the diversity of our society in the next REF period.

3. Income, infrastructure and facilities

Income

HESA research income increased by **154%** during the census period (from £287,476 to £729,043), while external studentship income increased **988%** (from £32,103 in 2014 to £349,351 in 2020). Funding sources include UKRI (e.g., AHRC, ESRC); European Union (e.g., ERASMUS+); charities and foundations (e.g., Help for Heroes); public sector (e.g., Cardiff and Vale University Health Board, South Wales and Gwent Police forces); national and international sporting bodies (e.g., English Institute of Sport, FIFA, World Rugby, British Gymnastics); and, learned societies (e.g., Physiological Society). While our HESA defined research income during

the census period is more modest in contrast to the external studentship funding, a recent increase in grant capture suggests a significant upward trend; in 2019-20 we secured **£510,637** in research funding as compared to £8,477 in 2013-2014. This growth is rooted in the School's strategy to increase and diversify research and innovation income, and to foster a sustainable research environment that provides for increased research quality, volume and impact.

Examples of externally funded research include **Lord's** Waterloo Foundation funded (£71,709) research with the University Hospital of Wales and Cardiff University. Using a randomised, controlled trial, it compares the effects of high-intensity interval training (HIIT) with moderate-intensity steady-state (MISS) training on wellbeing, cognitive performance and physical health in women with Polycystic Ovary Syndrome. The findings have the potential to inform exercise guidelines in disease management and a REF2028 ICS. **Stembridge, Oliver, Lord, Pugh** and **Talbot** also secured £55,292 from the Waterloo Foundation and a $25,000 USD FIFA Research Scholarship in collaboration with Cardiff University's Brain Imaging Centre and the Centre for Lung, Heart and Vascular Health at the University of British Columbia Okanagan. The research examines how brain blood flow and energy use differ at rest and exercise in pre- and post-pubertal boys and girls, and whether regular exercise alters control of brain blood flow. The findings could have significant health implications for children, providing an evidence base to inform public health promotion and policy. Finally, **Thomas** secured over £192k from South Wales and Gwent Police forces to improve levels of physical activity, psychological wellbeing and presentism within UK policing – a national and international collaboration with colleagues from Cardiff Met (**Moll, Neil**), Sheffield Hallam and the University of Tasmania. The research has already positively impacted the working practices and behaviour of control room staff and the forces' strategic direction in relation to physical activity in the workplace.

Given the strategic importance of PGR students to the research culture and its sustainability, a key School imperative during this period has been to increase the number of externally funded research studentships. We have had considerable success in this regard, securing externally funded studentships as the result of new and established collaborations with 'industry' partners. During the census period we secured **14** funded studentships (total value **£983k**) from the European Union and Welsh Government funded KESS-2 programme. This Wales-specific knowledge transfer programme links companies and organisations with academic expertise in the HE sector to undertake collaborative research that informs knowledge exchange activities by embedding the student within the company while they work towards a PhD or Research Masters. Collaborating partners included Cardiff and Vale Health Board, Sport Wales, I-Act for Positive Mental Health and Wellbeing, the Welsh Rugby Union, Wales Golf and the Valleys Gymnastics Academy. In several instances KESS studentships have built upon existing programmes of research, further strengthening ongoing collaborations and the quality and impact of the research. For example, having secured in excess of **£200k** for her injury surveillance research from multiple national and international sources (e.g., English and Wales Cricket Board, International Cricket Council, Welsh Rugby Union, World Rugby), **Moore** secured two KESS funded PhD studentships to further extend the application of knowledge to injury rehabilitation in rugby union.

Another key and highly successful funding source has been the ESRC Wales Doctoral Training Partnership. Since 2016 we have secured **5 ESRC DTP** funded studentships (total value approximately **£360k**). We have also secured studentship funding from the *Coleg Cymraeg Cenedlaethol*, a body established in 2011 by the Welsh Government to incentivise higher education teaching and research through the medium of Welsh. We have secured three such studentships to the value of **£127,315** during the census period. Considerable studentship funding has also been secured via a number of public and private sector collaborations and sources. For example, **Thomas, Evans** and **Lane** secured **£40k** from British Triathlon in collaboration with the English Institute of Sport and Bangor University to retro- and prospectively examine talent development within a psycho-social framework among elite British triathletes. Early findings from the project have already fed into the British Triathlon Athlete Development Framework. **Irwin** was a member of the research team in a similar collaboration between Cardiff Met and the Universities of Bath and Exeter that secured **£130k** from the Lawn Tennis

Association to gain insight into the key biomechanical indicators of performance that may be used to develop athlete-centred training programmes for improved performance. Collectively these studentships, some of which are match-funded, evidence the School's commitment to fostering research quality and pathways to impact. Notably, the four ICS that form part of this submission have resulted or benefitted from the aforementioned funding streams and studentships.

Infrastructure

The infrastructure that has been integral to realising the School's strategic priorities and the quality and impact of our research has changed across this REF cycle in-line with the changes to, and evolving aspirations of, the University's Senior Management. In 2017 the Cardiff School of Sport and Cardiff School of Health Sciences merged to form the Cardiff School of Sport and Health Sciences (CSSHS). However, throughout the REF cycle, research management within the School has rested with the Associate Dean, Research (ADR; 0.4 FTE), REF Coordinator (REFC; 0.4 FTE) and Graduate Studies Coordinator (GSC; 0.4 FTE) with the support of the Senior Researchers Group and Research Group Leads. Initially, Research Group Leads, all Professors, provided the operational support and leadership of seven cognate groups that reflected the central areas of research foci, strength and critical mass within the School. As a result of the merger, the structure of the research groupings was revised in 2019 to capitalise on the strengths of the newly formed CSSHS. This revised structure was intended to provide a catalyst for an increased research and innovation profile across sport, health, physical activity and wellbeing, as well as realise the interdisciplinary potential of the CSSHS. The revised structure consolidated the research groups across Sport and Health into four strategic research themes: (a) *Applied Sports Science*; (b) *Cardiovascular Health and Ageing*; (c) *Culture, Policy and Professional Practice*; and, (d) *Population Risk and Healthcare.* Within these themes, 23 research groups support the direction of all research (and innovation) activity in the CSSHS. Eleven of these groups feature in our current submission: High Performance; Philosophy and Ethics; Applied Injury Science; Sport Psychology; Youth Physical Development; Qualitative Research Methods and Social Theory; Cardiovascular Physiology; Performance Analysis; Sport Coaching; Applied Health, Physical Education and Lifelong Learning; and, Mental Wellbeing in High Performance Environments. All research groups continue to have an appointed Research Lead who provides both strategic guidance and support to group members. Collectively these Research Leads receive over **1,000 hours** workload allocation to undertake their roles and responsibilities. All groups feature senior, mid and early-career researchers as well as PGR students, and provide for an inclusive, dynamic, and supportive research culture and environment. The Senior Researchers' Group, which comprises all Professors and Readers, provide further strategic and operational support for all research-related activities, including reviewing, rating, and providing feedback to staff on the quality of their research activities and outputs. Research staff are supported by an administrative team consisting of a Research and Innovation Services Officer and two research administrators (2 FTE). A School R&I committee oversees all R&I related activities including policy, strategy, facilities, operations, and performance. A pan-University R&I committee, chaired by the PVC R&I, is responsible for overseeing all University R&I activities, supported by a centralised Research and Innovation Services unit.

Research Facilities and Environment

Since 2014, the School's research environment and facilities have been strategically enhanced through major capital investment in the physical infrastructure, and the replacement and upgrading of, research-related facilities and equipment. To elaborate, during this REF period the National Indoor Athletics Centre (NIAC) on our Cyncoed Campus was extended to provide a two-storey specialist strength, conditioning and rehabilitation facility to support our Youth Physical Development research activity. A further extension to NIAC enabled us to augment our existing purpose-built biomechanics research facility to include additional dedicated research and laboratory space. We also extended and enhanced our existing physiology and performance analysis research laboratories (total cost **£1.6m**). The equipment costs associated with this

enhanced physical infrastructure equated to a further **£190k**, an expenditure that was additional to the replacement and upgrading of other research-related equipment (a further **£1.5m**). For example, we invested in new Vicon systems (£150k); ultrasound hardware and state-of-the-art three-dimensional speckle-tracking software for the analysis of cardiac and vascular mechanics (£55k); respiratory analysis equipment for cardiopulmonary exercise tests (£75k); Kistler force plates (£75k); and, gym equipment for a new cardiac rehabilitation centre (£40k).

The infrastructure investment and capital expenditure outlined above has ensured the School continues to provide extremely well equipped and technologically advanced facilities to support all research activity. Our existing facilities include: five exercise physiology laboratories, including a dedicated cardiovascular suite; two purpose-built biomechanics laboratories that complement bespoke integrated in-situ research facilities within NIAC; three fully equipped performance analysis suites; and, the new 2-storey strength and conditioning training facility and laboratory. Each facility is fully equipped, for example, the physiology laboratories have a wide range of ergometers, respiratory gas analysis, temperature monitoring and a hypoxic chamber. A cardiovascular assessment suite houses six cardiovascular ultrasound devices, beat-by-beat blood pressure monitoring, and arterial stiffness via tomography. An additional range of equipment allows the interrogation and manipulation of the cardiovascular system (e.g., bespoke lower body negative pressure box with incorporated cycle ergometer). A team of 7.9 FTE dedicated technical staff provide support for our research activities including use of specialist research equipment, data collection and processing. Our staff also benefit from cross-school collaboration involving the use of a purpose-built tissue culture facility, licenced human tissue freezer bank and chemical analysis suite. These biomedical facilities are co-located within a 'Health Assessment Suite' that has supported clinical research trials with over 5,700 participating patients during the census period. Other facilities staff benefit from include the £147k Perceptual Experience Laboratory (a mixed reality laboratory in our School of Art & Design that can simulate real world environments using immersive sound, smell, temperature and vision).

Our staff have also formed external strategic alliances and collaborations that facilitate access to a wider range of world-leading facilities and infrastructure. Locally, this is demonstrated by our four externally funded interdisciplinary projects with the School of Physics and Astronomy at Cardiff University Brain Imaging Centre (CUBRIC), a £44 million, purpose-built centre housing four magnetic resonance imaging laboratories. Internationally, our collaborations include ongoing research with the Centre for Heart, Lung and Vascular Health at the University of British Columbia Okanagan. Over the last six years, this collaboration has yielded over **48 joint publications**, involved two jointly supervised PhD students, and the bi-directional mobility of academics (**Stembridge, Lord, Pugh**), technical staff (**Dawkins, Talbot**) and **11 PGR students**. The Centre boasts seven world-leading laboratories for the assessment of integrative and clinical physiology, all funded by the National Sciences and Engineering Research Council, Canada. This ongoing collaboration has facilitated access to techniques such as invasive measurements of cerebral metabolism and the dynamic control of end-tidal gases that would have otherwise not been accessible.

Our research environment is also enhanced through our support of and collaborations with key stakeholders, including through formal agreements. For example, we are one of only three FIFA Medical Centres of Excellence in the UK and 57 globally; one of the central aims of which is applied and novel research to support FIFA's long-term development strategy. We also have written partnership agreements with, and are the Centre of Excellence for, several national organisations and governing bodies of sport, including Welsh Triathlon, Welsh Athletics, Welsh Netball and Disability Sport Wales. 'Sport Cardiff', which is an integral part of the University and the 'go to' body for community sport in Cardiff, addresses social inequalities through sport and physical activity ensuring a lifelong enjoyment of sport for all. These partnerships provide an important conduit for some of our impactful research activity.

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

Contribution to the Research Base, Economy and Society

During the census period our staff have made significant and wide-ranging individual and collective contributions to the research base, economy and society. The scope and effectiveness of their contributions are evidenced through their advisory roles within professional bodies, collaboration and engagement with key stakeholders, service providers and end users, and contributions to the sustainability of the discipline nationally and internationally. All staff are supported in undertaking external engagement activities, which enhance the standing of both the School and our staff, as well as the quality and impact of our research and innovation activities.

Professional service and advisory roles held during the census period with policy makers, research users and beneficiaries are wide-ranging: REF2021 Panel Member UoA24; ESRC Peer Review College Member; AHRC Clwstwr Steering Board Member (**Hanton**); Academy of Social Sciences Council Member; ESRC Peer Review College Member; CBI Wales Council Member; Cardiff Capital Region City Deal Economic Growth Partnership Board Member (**Aitchison);** Sportscotland and Sport Wales Board Member; Olympic Committee, Olympic Solidarity Commission Advisor (**Robinson**); British Gymnastics Non-Executive Director (**Bolton**); Public Health Wales Non-Executive Director; Public Health England Mental Health Campaign 'Every Mind Matters' Expert Advisor; International Expert member of National Development Group, University of British Columbia and Canadian Society for Exercise Physiology (**Crone**); Health Care Professions Council, Registrant Council Member; Cardiff and the Vale Health Board Scientific Review Committee Member; Wales Public Health Improvement Research Network Advisory Board Member; Welsh Rowing Board Member (**Thirlaway**); SportsCoach UK Director; UK Coaching Committee Chair (**Smith**); Sport Wales Board Member (**Longville**); Equality Challenge Unit Athena-SWAN Panellist (**Gittoes**); Women and Science and Engineering Board Member (**Lord**): ESRC (Wales) DTP Management Board Member (**Evans**); BASES CPD Committee Member; BASES Safeguarding and Welfare Advisory Group Chair (**Miles**); English Premier League Growth Maturation Advisory Group Members (**Lloyd, Oliver**); American College of Sports Medicine CPD Content Developers (**Lloyd, Oliver**); UK Strength and Conditioning Member Board of Directors (**Lloyd**); World Rugby, Medical Steering Group Member; Premiership Rugby, Science Advisory Group Member (**Mellalieu**); BASES Equality, Diversity and Inclusivity Committee Member; Welsh Rugby Union and PRO14 League Injury Surveillance Group Chair; English and Welsh Cricket Board Injury Surveillance Group Member (**Moore**); Badminton World Federation Sport Science Commission Member (**Hughes**); *Fédération Internationale de* Football Association (FIFA) Medical Centre of Excellence Co-Director; *Federation of Internationale de Gymnastique* Expert Advisor; British Gymnastics Scientific Advisor; Football Association Wales Medical and Performance Group Member (**Irwin**); Sport Wales Physical Literacy Advisors (**Morgan**, **Edwards**); British Universities Colleges Sport Mental Health Network Board Member (**Mellick**).

Further contributions to professional bodies, learned societies and recognition for substantive contributions through Fellowships and elected positions include: Academy of Social Sciences Fellow (**Jones R**); Royal Statistical Society Fellow (**Cooper**); World Leisure Academy Senior Fellow (**Aitchison);** International Society of Biomechanics of Sport President (**Irwin**); International Association for the Philosophy of Sport President (**Hardman**); International Society of Biomechanics of Sport Fellow (**Bezodis**); British Psychological Society Division of Sport and Exercise Psychology Education and Training Committee Members (**Evans, Thomas).**

In terms of indicators of wider influence, and contributions to, and recognition by the research base, **21** staff have fulfilled editorial roles for world-leading peer review journals and **4** hold the role of **Editor-in-Chief** (i.e., **Mellalieu** - Journal of Applied Sport Psychology; **Jones R** - Sports Coaching Review; **Hanton** - The Sport Psychologist; **O'Donoghue** - International Journal of Performance Analysis in Sport). Staff have also held **17 Section or Associate Editorships** across 14 different journals. For example, Journal of Applied Sport Psychology (**Evans, Mellalieu)**; Journal of Sport Science and Medicine (**Neil)**; Journal of Strength and Conditioning

Research (**Lloyd)**; Sport Biomechanics (**Irwin)**; Sport, Leisure and Tourism: Frontiers in Sports and Active Living (**Hardman**); Annals of Tourism Research (Leisure and Recreation; **Aitchison**); Journal of Global Sport Management (**Robinson**). In total, staff have held **55 Editorial Board positions** and **Guest Journal Editorships** across **48 journal titles** during the census period (e.g., Frontiers in Sociology; Journal of Applied Sport Psychology; Journal of Sports Sciences; Qualitative Research in Sport, Exercise and Health; Quest; Societies; Sports Biomechanics; Sport Coaching Review; Sport Education and Society; Sport, Ethics and Philosophy; The Sport Psychologist).

Our staff's international standing and contribution to the research base are also reflected in the number of invited keynote addresses, presentations and Visiting Professorships during the census period. Staff have delivered **37 invited keynote** addresses and over **90** invited presentations spanning national and international organizations and conferences, including: the Royal Society of Medicine (**Lloyd**); American College of Sports Medicine (**Stöhr**); Association for Sport and Exercise Sciences (**Bezodis**); The Physiological Society (**Stembridge, Stöhr)**; British Association for Sport and Exercise Medicine (**Lloyd, Moore**); International Society of Biomechanics (**Moore**); International Association for the Philosophy of Sport (**Hardman, Jones C**); British Association for Cardiovascular Prevention and Rehabilitation (**Neil**); British Psychological Society Division of Sport and Exercise Psychology (**Crone**); Sport Global Governance Conference (**Edwards**); Global Sport Science Conference (**Jones R**); European College of Sport Science (**Stembridge**); London Marathon Medicine Conference (**Evans**); National Strength and Conditioning Association Conference (**Lloyd, Oliver**); Public Health Wales (**Mellick**); Sport Performance Research Institute New Zealand (**Oliver)**; and, UK Policing's 'Oscar Kilo' Upbeat Conference (**Thomas**)**.** Visiting and Honorary Professorships include: Auckland University of Technology (**Irwin, Oliver**); Norwegian School of Sport Science (**Jones R**); University of Ostrava (**Irwin**); University of Innsbruck (**Stembridge**); *Universita' Degli Studi di Catania*, Italy (**Laudani**); University of South East Norway (**Jones R**); and University College Newman, Birmingham (**Mellalieu**). In total **20 staff** have fulfilled visiting research roles at other institutions.

Further evidence of the contribution of staff and their standing in the research community is provided by invited grant reviews undertaken. Staff have completed over **30 grant reviews** for cherished and prestigious national and international funding sources, including: Diabetes UK (**Stöhr**); Heart Research UK (**Stembridge**); Arts and Humanities Research Council (**Jones R**); The British Academy (**Evans, Jones R**); British Heart Foundation (**Hughes**); Economic and Social Research Council (**Jones C, Mellalieu, Thirlaway**); Engineering and Physical Science Research Council (**Irwin, Stöhr**); Leverhulme Trust (**Evans, Mellalieu**); National Research Foundation of South Africa (**Mellalieu**); Natural Sciences and Engineering Research Council of Canada (**Pugh; Stembridge, Stöhr**); Royal Society (**Irwin**); Rosetrees Trust (**Moore**); and, Social Sciences and Humanities Research Council of Canada (**Dohme, Mellalieu, Moll**).

Reflecting their international standing, **22** staff have also served on the organising and scientific committees of a wide range of national and international conferences, including the: International Society of Biomechanics in Sport Annual Conference; British Association of Sport and Exercise Sciences Annual Student Conference; British Psychological Society Division of Sport and Exercise Psychology Annual Conference; European College of Sport Science Annual Congress; International Association of the Philosophy of Sport Annual Conference; British Association of Sport and Exercise Sciences Annual Conference; International Congress on Sport Science Research and Technology; UK Strength and Conditioning Association National Conference; International Conference Cluster for Research in Coaching; and, pan-Wales PGR Sport and Exercise Sciences Conference.

The quality of our research and impact has also been recognised by the awards our staff and doctoral students have received (n = 21) and been shortlisted for (n = 26). For staff these include: Times Higher Education Research Project of the Year Award shortlist for the 'Comparison of the biographies of GB serial medal and non-medalling Olympic Athletes' (**Evans**); Winner, Warren Fraleigh Distinguished Scholar Award - International Association for

the Philosophy of Sport (**Jones C**); Winner, European College of Sport Science Young Investigator Award and Winner, Hypoxia Symposium Early Career Award (**Stembridge**); Winner, BASES Early Career Practitioner Researcher Award (**Moore**); and, Winner, Outstanding Young Investigator of the Year – National Strength and Conditioning Association (**Lloyd**).

The awards our doctoral students have been recipients of include: Physiological Society, Winner, Best Oral Presentation (**Meah**); Physiological Society, Winner, Michael J Rennie Best Oral Communication; Physiological Society, Winner, Rob Clarke Award (**Simpson**); International Society of Biomechanics in Sport, Winner, International New Investigator Award; International Society of Biomechanics in Sport, Winner, Hans Gros New Investigator Award (**Manning**); Okanagan Cardiovascular and Respiratory Symposium, PhD Student Presentation Runner-up and Physiology Society Europhysiology, Winner, Early Career Research Poster (**Wakeham**); and, British Association for Sport and Exercise Sciences, Winner, Biomechanics Oral Student Special Interest Group Presentation (**Brazil, Burton**).

Collaborations

The quality, significance and reach of our research has been considerably enhanced by the collaborations, networks and partnerships staff have been involved with. Nationally our collaborative research and impact activities have been enhanced by our involvement with bodies such as Sport Wales' Welsh Institute for Performance Science (WIPS - **O'Donoghue**, **Oliver**) and the Welsh Institute of Physical Activity, Health and Sport (WIPAHS - **Crone, Thomas**). Supported by Welsh Government funding, they bring together Welsh academics to enable Sport Wales to attain its strategic policy and practice priorities around sporting performance and the physical activity and health of the Welsh nation. Other Sport Wales collaborations include, the Physical Literacy Programme for Schools Project, a collaboration between Sport Wales, Cardiff Met (**Morgan, Edwards**) and the Universities of Wales Trinity St David, Bangor and South Wales to support the development of Physical Literacy across Wales. The project findings have been used to guide Physical Literacy education and its development by Sport Wales. Our research has also benefitted from and provided benefit to a range of governing bodies of sport and key national and international stakeholders, including the Welsh Rugby Union, Welsh Athletics, Football Association of Wales, England and Wales Cricket Board, British Athletics, British Triathlon Federation, English Institute of Sport, UK Sport, and Lawn Tennis Association. Internationally, collaborations extend to, for example, the Federation of International Gymnastics (**Irwin**), World Athletics (**Bezodis**), World Rugby (**Irwin, Moore, Mellalieu**), International Cricket Council (**Moore, Ranson**), *Federation Internationale de* Football Association (FIFA; **Irwin, Stembridge, Oliver, Lord, Pugh**), and International Olympic Committee (**Robinson**).

Our research collaborations have also responded to and addressed a number of pressing health and wellbeing imperatives. For example, **Jones C's** ESRC funded collaboration with the Living Room Cardiff (a community based addiction recovery centre) and Swansea and Bath Universities addressed the increasing incidence and manifestations of addiction (alcoholism, gambling and disordered eating behaviours) among athletes, and the role that sport can play in recovery from them. The research provides important new insights into the nature of addiction within sport and exercise contexts and improves our understanding of the addictive process and recovery from it. **Pugh's** Health Care Research Wales funded collaboration with the University Hospital of Wales and local General Practice Surgery clusters involves the first randomised controlled trial of the independent and combined effects of exercise training and statin therapy on blood vessel function in vulnerable individuals at risk of cardiovascular disease (CVD). The project utilises cutting-edge ultrasound techniques to provide healthcare practitioners with an initial evidence-base to endorse regular exercise as a low-cost intervention to augment the cardio-protective benefit of statins, potentially leading to greater CVD-risk reduction and substantial healthcare savings. Other examples that evidence the diversity of our collaborations with regional and national stakeholders, research users, and beneficiaries include: the Aneurin Bevan Health Board (**Lord, Pugh**), South Wales and Gwent Police forces (**Thomas, Moll, Neil**), Cardiff Orthopaedics (**Evans**), *Conservatoires* UK Association of British Orchestras and British Association for Performing Arts Medicine (**Wasley**), Wales Heart Research Institute and Wales

Gene Park (**Cooper**), Mind UK (**Mellick**), and Cardiff and Vale University Health Board (**Laudani, Crone, Moore**).

The global reach of our international research engagement and collaboration extends to **75 countries** (see map). The following examples illustrate the nature of these collaborations, the breadth of our stakeholder partnerships and the collaborative arrangements for PGR training that they provide. PGR training and research collaboration is at the heart of a bilateral inter-institutional international agreement between Cardiff Met (**Laudani**) and the University of Rome *Foro Italico* (neuromechanics group led by Macaluso) supported by Erasmus+ mobility funding. This collaboration, which has supported staff and student mobility and collaborative research since 2016, has enabled four University of Rome students to spend 6-12 months conducting research at Cardiff Met and three Cardiff Met students to conduct their research at either the Functional Assessment Laboratory of Villa Stuart Sports Clinic (FIFA Centre of Excellence) or the Neuromechanics Laboratory of the University of Rome. The collaboration has also been a catalyst for joint supervision, enhanced quality research training, and student involvement in a number of high-quality multi and interdisciplinary research projects and outputs.

In 2015 **Lloyd** and **Oliver** were supported by **£47k** from the university Research, Enterprise and Innovation Fund to enter into a similar arrangement with Auckland University of Technology (AUT; Cronin, Harrison) in the field of youth physical development. The partnership involved the cross-fertilisation of programmes of research, joint research student supervision, staff and research student mobility, and the shared translation of research into professional development activities for external agencies. Five jointly supervised PhD students have completed or submitted since the partnership started, with a further four students currently enrolled. The partnership also created opportunities for wider collaborations, including with the National Institute of Fitness and Sport in Japan. Eight Cardiff Met and four AUT staff have participated in exchange visits and week-long writing retreats. The funding also contributed to **Oliver** and **Lloyd** securing two fully funded KESS PhD studentships (value circa **£140k**). Since 2015 the partnership has resulted in **27** co-authored peer-reviewed journal outputs and influenced professional practice locally and globally (as evidenced by the Youth Physical Development ICS). Another partnership with the Cincinnati Children's Hospital Medical Center (Myer) in the fields of paediatric strength and conditioning and sports medicine resulted in a further four PhD completions, **55** jointly authored peer-reviewed papers, international grant capture and the

National Strength and Conditioning Association position statement on long-term athletic development, which has had significant global impact on youth sport policy.

Successful collaboration in relation to high quality PGR training is also evidenced by the ESRC (Wales) collaborative DTP pathway in Sport and Exercise Sciences. The success of the collaboration and the quality of PGR training is exemplified by ESRC Wales' approval of the research training at Cardiff Met (MRes in Sport & Exercise Social Sciences) as meeting ESRC research training standards.

The success of our global collaborations are further illustrated by successful collaborations with some of the most prestigious Universities and University departments in the world. **Stöhr's €252,000** European Commission Horizon 2020 Marie Sklodowska Curie Actions Fellowship funded a two-year fellowship at Columbia University Irving Medical Centre, the number one medical research centre in the world (Nature Index), to conduct a novel study into macro and microvascular differences in blood flow haemodynamics in patients with Left Ventricular Assist Devices (LVAD). This ground-breaking research has meant that patients with heart failure fitted with a LVAD can now have their blood pressure measured where this was not previously possible. This research also contributed to **Stöhr** and colleagues recently being awarded a Welsh Government grant of **£98k** to examine the effects of COVID-19 on the mechanisms of drug treatment for hypertensive individuals – illustrating our responsiveness to evolving health imperatives.

Finally, the global nature of our research collaboration is also illustrated by our involvement in **five large-scale scientific expeditions on three different continents** to examine altitude-related chronic health. Institutionally led by **Stembridge**, each of these expeditions involved a range of academics spanning Professors to undergraduates. Co-investigators from the United Kingdom (Cardiff Met, Bangor University, University of Cambridge), Canada (University of British Columbia, University of Alberta, Queen's University, University of Manitoba), United States of America (Duke University, Loma Linda University, University of Texas, University of Colorado) and Netherlands (University of Twente) collaborated with local academics and physicians (e.g., *Universidad Peruano Cayetano Heredia*, Peru) to deliver 15-20 unique and distinct multi and interdisciplinary research projects over the course of each three to four week expedition. The work was supported by grants from funders such as the National Sciences and Engineering Research Council (Canada), Canadian Institute of Health Research, Wilderness Medical Society, The Physiological Society, Santander Universities, and American College of Sports Medicine. The research findings are directly relevant to the tens of millions of people who annually travel to high altitude locations as part of the global tourism industry, and the 140 million people who reside at high altitude across the globe.