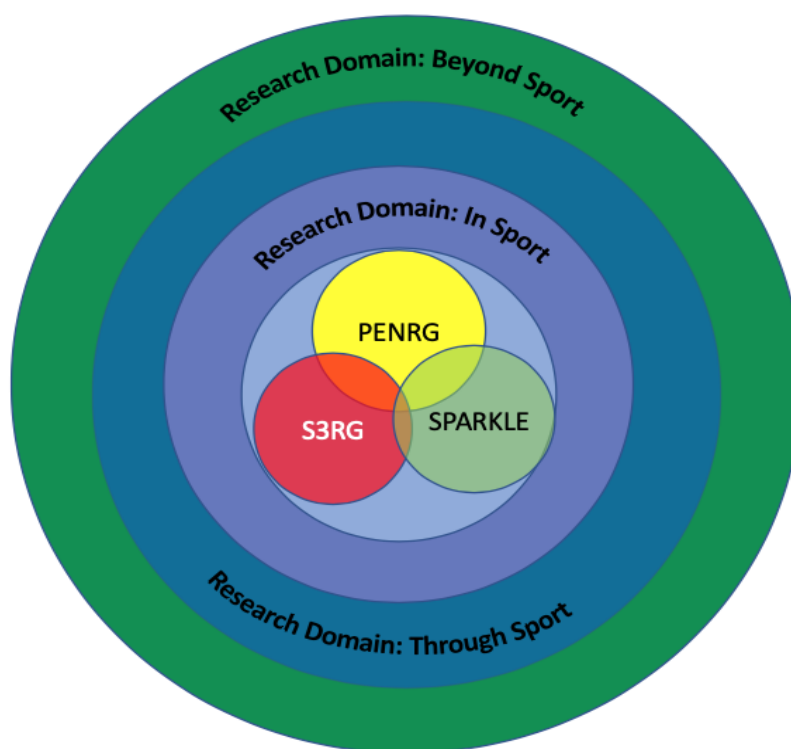


Institution: University of Stirling
Unit of Assessment: C24 Sport and Exercise Sciences, Leisure and Tourism
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1. Overview of UoA Context, Structure and Strategy</p> <p>We are a community of sport researchers and practitioners located in the Faculty of Health Sciences and Sport at the University of Stirling, Scotland's University for Sporting Excellence. We have 26.8 FTE (n=27) staff, consisting of 2 Professors, 4 Associate Professors, 5 Senior Lecturers and 16 Lecturers. Collaborative working ensures agility to respond to societal and industry needs, such as our responses to Covid-19, as evidenced, for example, through our recent grant success with the Chief Scientists Office Scotland.</p> <p>Our research addresses sport and health challenges for people engaged in professional and amateur sport, the sport and leisure industry, and individuals undertaking exercise and physical activity. We strive to deliver research that has a demonstrable impact through a focus on sport that supports people to maintain, attain or regain good health, well-being and performance. Our organisational structure promotes close interdisciplinary working on sport and health challenges and since merging into the Faculty of Health Sciences and Sport in 2016 the opportunity for interdisciplinary research is much improved. We focus on engagement and collaboration with public sector organisations, the sport industry, participants in exercise and physical activity, and academic partners in the UK and overseas. Our outputs demonstrate this, with 81% of our papers co-authored by external collaborators and 43% with international collaborators.</p> <p>1.2. Research Organisational Structure</p> <p>Our research structure consists of three research groups united under the umbrella Sport, Health and Exercise Research and Education (SpHERE) community. Staff work across three inter-related research groups: The Physiology, Exercise and Nutrition Research Group (PENRG), the Sport Social Science Research Group (S3RG) and Stirling Physical Activity Research, Knowledge & Learning Exchange (SPARKLE) Research Group.</p> <p>Our research focuses on three inter-related domains - <i>In Sport</i>, <i>Through Sport</i>, and in the health and exercise sciences <i>Beyond Sport</i>:</p> <ul style="list-style-type: none"> • <i>In Sport</i> research focuses on sport itself, addressing sport experiences and delivery from diverse disciplinary perspectives including sport management, sport coaching, sport governance and policy, and sport and exercise science. These studies span recreational to elite sport, and community to global organisations and structures. • <i>Through Sport</i> research is focused on the social contributions of sport, addressing sport as a context within which social, economic and cultural challenges are addressed. • <i>Beyond Sport</i> research is focussed on the benefits of sport, health and exercise sciences to individual health outcomes, economies and populations.

Interdisciplinary research that engages stakeholders, addresses sport and health challenges, supporting people to attain or regain good health, well being and performance



SPHERE: inclusive knowledge community in sport health and exercise

FIGURE 1: Overview of Research Organisational Structure and Focus

Physiology, Exercise and Nutrition Research Group (PENRG) [Galloway – Lead, Hunter, Moran, Brooks, Volvaard, Macgregor, Di Virgilio, Rodriguez Sanchez]

The PENRG research group conducts research from cells to systems that improves human health and performance. PENRG has 8 academic staff members (including 3 Early Career Researchers), 3 post docs, 13 PhD students, 4 MPhil students, and 2 technical staff members. The group has secured >£1.5M in research and knowledge exchange funding since 2014.

Funded project highlights include:

- in genetics and molecular biology, work on HLA genotyping in conjunction with University of Glasgow;
- in nutrition and fluid balance, work on performance nutrition funded by Maurten AB, PepsiCo, Lucozade Ribena Suntory, and Nutricia-Danone, and an MRC funded study investigating nutritional intake and sarcopenia in South African urban townships;
- in neuromuscular function, for work funded by sportscotland on tensiomyography as a tool to guide training and recovery in elite athletes, and from The Mentholatum Company for topical treatments on soft tissue.

We have undertaken a range of development work, for example, in providing research training to academics in historically disadvantaged institutions in South Africa, and a KTP award for youth soccer player development. We have international partners in South Africa, India, and Costa Rica. and achieved a European ESPEN fellowship grant (£32,529).

Sport Social Science Research Group (S3RG) [Henning and Rocha – leads; Dimeo, Kay, Zipp, Morrow, Taylor, Hong, Wilkinson, Bradley, Allen, Overbye, Kolyperas]

The S3RG research group is a multi-disciplinary group combining management, psychology, sociology, social policy, and coaching studies in research on issues related to the role of sport in society, locally and internationally. S3RG has 13 academic staff members (including 5 ECRs) and 10 PhD students. The group has secured >£ 304,725 in research and knowledge exchange funding since 2014. Funded project highlights include:

- in Sport management, governance, and policy, work on alcohol consumption policy in football, on the implications of menstruation for girls' sport development in Zambia, and, on displacement impacts of the Rio Olympics;
- in Sport, community, and society, work funded by the World Anti-Doping Agency on social change and perceptions of doping, and on parental roles in anti-doping for young athletes;
- in Performance sport, work funded by International Olympic Committee on organisational support for eSports players;
- in Sport coaching and leadership, work on developing women hockey coaches and participants supported by Scottish Hockey.

We have a particular strength in supporting ECRs to develop their international networks and associated research impact as evidenced by: hosted international knowledge exchange events on doping and polydrug use (Henning, Wellcome Trust); developing the UK Menstruation Research Network (Zipp, Wellcome Trust); research on dual career support for student-athletes (Hong, Erasmus + Programme, £51,125.75). Other ECRs have attracted international grants from the IOC (£14,461, Hong, Wilkson) and the Danish Research Council (£23,826, Overbye).

Stirling Physical Activity Research, Knowledge & Learning Exchange (SPARKLE) [Whittaker – lead, Ryde, Connolly, Kirkland, Coffee, Neely]

The SPARKLE research group focuses on Physical Activity research across the lifespan, including child activity, diabetes/obesity, workplace wellbeing, and healthy ageing. It develops and refines interventions to increase physical activity, centred on areas of psychology, sociology and physiology. SPARKLE has 6 staff members (including 4 ECRs), 1 post doc and 13 PhD students. SPARKLE is a new group, established in 2019 to build on emerging research strengths, with strategic University investment in six academic posts including professorial leadership (Whittaker). The group is building strong momentum and research project highlights include:

- in Health Behaviour Change, work on physical activity interventions in frail older adults;
- in Sport, Exercise and Wellbeing, work on holistic talent identification and development in youth soccer players, funded through an Innovate UK KTP;
- in Health Promotion, work funded by the Chief Scientist's Office on enhancement of dietary education for Type-2 diabetes prevention.

1.3. Research Strategy

We have made clear progress against the research strategy we laid out in 2014. A key strategic approach has aimed to focus on research addressing global societal challenges, particularly in relation to sport and health. Accordingly, we have consolidated our work into our three inter-related domains that have clear impacts for society: *In Sport*, *Through Sport* and *Beyond Sport*.

One key target, to increase research income, was achieved by submitting larger interdisciplinary collaborative grant applications and taking a developmental approach towards those applications. Another key target, to support the development of researchers in order that the quality of research and related outputs could be increased, was achieved by investment in employment of, and capacity building for, staff at all levels to support specialisation in topic and methodological areas of expertise. We have invested in an impact strategy and staff to achieve health and sport gains

for society and individuals by making stronger strategic links to practice, industry and policy. In addition, we have broadened our national and international collaborations and attracted more PGR students.

1.4 Future Research Strategy

Our strategic vision beyond 2020 is to build on our strengths in mission orientated, applied research that offers solutions to the socioeconomic and health challenges of the future. These will include reducing the difference in health outcomes between communities and individuals, particularly in left-behind places and in key demographic areas including healthy ageing and in children. Critical to furthering our understanding of sport and health at an individual and population level to impact upon elite and amateur athletes, as well as participants in exercise and physical activity, is our intention to further strengthen our research capabilities through researcher development, recruitment and retention.

The University-led innovation workstream of the Stirling and Clackmannanshire City Region Deal provides a key platform and unique opportunity for transformational research. Direct investment of £46m by the UK and Scottish governments is delivering economic and social transformation through major research and innovation infrastructure developments. An Intergenerational Living Innovation Hub (£7.2m investment) will provide a community based test-bed for new approaches to changing demographics, while Scotland's International Environment Centre (£22m) will focus on resilience in the natural and social environments. With these developments creating a regional scale 'living laboratory', we have plans for applied sport research projects, particularly in collaboration with colleagues in other research centres and groups including Ageing, Community Resilience and Data Science. For example, we will examine the use of green space and commuting habits and their effect on physical activity for the population at regional scale.

Our ambition is also to further strengthen our leadership of large national and internationally funded multidisciplinary funded projects. Our future strategy aims to increase our funding trajectory through targeting a broader range of funders, greater mission-oriented and interdisciplinary work to secure large grants and Programme/Centre funding. We will maintain our research agility to respond to global sport and health needs by ensuring we have staff in post with the correct skills. For example, working with our colleagues within the Faculty, we are developing our methodological expertise to develop and undertake clinical trials in physical activity interventions to tackle mental health issues in children and young people. We plan on applying for larger programme grants in the areas of nutrition, and working across disciplines such housing, water quality, and health providers to address non communicable diseases. We will target development funding for ECRs and securing Fellowships for more established staff.

We will invest in equipping staff with the necessary skills to contribute to the collaborative development, testing and implementation of user-led innovations for living well. This strategic direction will require increased interdisciplinary working and expanded collaborations with businesses, sports organisations, and other stakeholders. This will broaden the experience of our staff in industry collaborations, intellectual property, and commercialisation of ideas or products. For example, The Scottish Government's economic strategy highlights Healthtech and Food and drink innovation as two key areas for inward investment. We already have some experience in company collaboration in these areas, including software design for youth soccer player development with Soccer PDP and our partnership with a local fitness equipment company, BGR training Ltd, and will expand our portfolio of collaborative business projects.

1.5 Interdisciplinary Research

We are the Sport experts at the heart of the University of Stirling's three interdisciplinary research themes: *Cultures, Communities and Society*; *Global Security and Resilience* and *Living Well*. We work predominately within the *Living Well* theme leading areas of work and collaborating with colleagues in the other themes. Our research contributes to five institutional Research

Programmes: Ageing and Dementia; Global Food Security; Health and Behaviour; Mobile Cognition; Cultural Heritage. Examples include:

- our work on mobile cognition with neuroscientists from Psychology working with members of PENRG, interfacing electroencephalogram (EEG) with electromyography (EMG) technologies. This has enabled better understanding of feed forward and feedback loop between brain signalling and skeletal muscle recruitment. These technologies have been rolled out to fund PhD studentships examining neurological impacts of soccer ball heading and ageing on gait control and mobility;
- the Institute of Marketing and Health are working with us on our Scottish Funding Council GCRF project 'Long Covid' in severe Covid-19 survivors in The Eastern Cape, South Africa using mixed methods of qualitative (interview) and quantitative (physical function assessment);
- collaborating with the Institute for Social Marketing and Health on the project "Football Fans in Training" which is promoting weight loss in male football fans.

Capacity building activities to support interdisciplinarity include an annual university-wide Festival of Research (67% of our researchers attended), and the Stirling Crucible Researcher Development Programme (6 SpHERE staff have attended since 2014) that provides training and seed funding for impactful interdisciplinary projects for early and mid-career researchers. For example, Macgregor was awarded £1,000 with colleagues from psychology to explore the impact of foam rolling on pain management. Part of this work has led to a PhD studentship funded by sportscotland in preparing athletes for elite competition. A former ECR colleague was also awarded £1000 and produced an output Mussel Consumption as a "Food First" Approach to Improve Omega-3 Status" in collaboration with Galloway and a colleague in the Institute of Aquaculture.

SpHERE, our overarching Sport community, is explicitly designed to cultivate interdisciplinarity between our three research groups. SpHERE promotes interdisciplinarity through shared communication of each group's scheduled activities, and through quarterly collective research development workshops for all members. Workshops conclude with a "research showcase" hour during which colleagues present short updates of activities including current projects, emerging bids and collaboration opportunities, and upcoming events. Members of each group are encouraged to participate in other groups' activities, logged on a central SpHERE calendar. Interdisciplinary collaboration is evident across current projects, e.g. The Daily Mile project includes members of PENRG and SPARKLE, and the #MeTime project has members from all three research groups. SPARKLE's formation reinforced this strategy, applying an interdisciplinary approach to physical activity.

Our work in enhancing interdisciplinary capacity and capability, and research on marginalised communities, has led us to successfully jointly leading a Doctoral Training Programme in South Africa for Health Faculties in previously disadvantaged South African Universities. To enable us deliver on this programme we have reached out to a number of colleagues across the faculty and university to supervise a range of research questions that include household smoke exposure, blood management, LGBTQ issues of staff / health workers, decolonising occupational therapy, pre-eclampsia, colorectal pathology, physical therapy for preventative and rehabilitative health care, wellbeing and quality of life with HIV, malnutrition/childhood obesity, and mental health of health care workers.

1.6 Approach to enabling impact

Our research approach to impact is rooted in collaboration and partnership with research users. We work closely with stakeholders to identify, undertake, and disseminate research serving people from marginalised communities to elite professional sport. We benefit from our official status as Scotland's University for Sporting Excellence, which (1) connects us to priority research and knowledge needs within sport, health, and exercise; (2) facilitates partnerships with funders, users, and disseminators of our research, including on-campus sport agencies and Scotland's

Observatory of Sport; (3) provides excellent networks for impact and knowledge exchange and; (4) offers a unique high-quality physical infrastructure supporting research from recreational community participation to elite sports performance.

We are committed to research that is valued beyond academia and leads to significant improvements to *Living Well*. Our impact sits across all three topics: *In Sport*, *Through Sport* and *Beyond Sport*. Impact lies at the heart of our research and we have further intensified impact within our research culture by a range of actions.

Our strategic approach to enabling impact is aimed to improve sport and health through close engagement with stakeholders and high-quality applied research. Our impact strategy is based on a fundamental commitment to a mission-oriented approach to impact and its effective dissemination.

Investment and leadership, provided by a Faculty-funded Impact Champion and two Impact Research Assistants, means that delivery of our impact strategy is maintained and enhanced. This targeted funding, peer mentoring and a programme of researcher development within the University, has enhanced our focus on research impact.

Our strategy to maintain and develop impact has 4 key elements:

1. **Relationships:** Nurture existing relationships with key stakeholders (public, employers, practitioners, policymakers) whilst seeking opportunities to develop new relationships;
2. **Education and culture:** Embed understanding and opportunity for impact within ongoing research processes, including annual appraisal and development reviews, training and sharing best practice;
3. **Planning for impact:** Impact planning is part of our annual review process, ensuring impact is an embedded part of research planning;
4. **Dissemination:** Continue to work closely with the University's Public Affairs Manager and Communications Team to maximise opportunities to produce targeted promotion of research with impact potential.

Our impact case study authors act as 'impact ambassadors', sharing knowledge, skills, connections and insights gained during their journeys to successful impact creation. This collaborative approach allows us to proactively identify and respond to challenges/opportunities that arise from changes in circumstances. We share our best practice and learn from others across the institution through engagement with Impact Champions in other faculties and divisions and the institutional Impact Working Group. The importance of impactful research is recognised and rewarded within our appraisal and development process, Achieving Success, and as a criterion for research leave.

At the University level, dedicated impact co-ordination, support, and tracking is provided by a Research Impact Officer within Research and Innovation Services, which also oversees internal and external impact training for staff and research students via the Researcher Development Programme and Institute for Advanced Studies.

Our chosen impact case studies exemplify our approach of working directly and continuously with stakeholders including the sport industry, sport governing bodies and physical activity participants. Our researchers in *In Sport* worked in partnership with sportscotland Institute of Sport on improving elite athletic preparation and performance through neural measurement leading to specific changes in training and evaluation of performance, thus informing and enhancing success at major international events. Our researchers in *In Sport* and *Through Sport* worked in partnership with USA Cycling within their anti-doping research and subsequent membership of an international committee on anti-doping policy and practice. Our partnership approach with participants in sport and the wider benefits associated with sport, is exemplified by our researchers in *Through Sport* and *Beyond Sport* work in partnership with primary schools on the Daily Mile. Our research case

studies were specifically chosen to show the diversity of our impact portfolio based on our research in sport and health, across both elite performance and participants in exercise and physical activity.

1.7 Open access research

All staff upload research outputs into the University's open access institutional repository through Worktribe, the research management system. Publications then appear on staff web profiles, and can also be located through the University's Research Hub searchable web interface. Outputs are made available automatically or, if under publisher embargo, via an automated request function which is directed to the author, thereby allowing staff to give access to the requested output. The University provides funding for Article Processing Charges which is available to all research-active staff. This has funded open access publishing of 37 of our papers. The University also supports open research data management through training, guidance and support and an online repository, DataSTORRE.

1.8 Research integrity

We are committed to the highest possible ethical standards. We promote a culture of best practice and integrity in all our research through the core values of honesty, rigour, open communication, care and respect. To safeguard the interests of researchers, participants and funding bodies, research only proceeds after ethical scrutiny and approval.

Through the three research groups research integrity is promoted via leadership, mentorship and peer review. For example, the groups all have weekly meetings whereupon research concepts bid proposals are presented to allow informal peer review and discussion before formally submitting faculty approval for bid development and formal peer review. A similar process also takes place prior to submitting applications to internal or external ethical review boards. We develop new approaches to integrity as required by our research. A specific example of this process was when we were deciding how to ensure capacity to consent for older isiXhosa speaking people in a South African Township. Following informal peer review at PENRG meeting the project partner gerontologist was contacted alongside the project fieldworker who advised us to ask the project participant to explain back to the RA the research project information after it was explained to them. If the participant's explanation of the project was sufficiently accurate then we considered that they had capacity to consent which was subsequently approved by our institutional ethics panel.

2. People

2.1 Staffing strategy and staff development

Recruiting, retaining and supporting researchers with the highest potential to achieve excellence in our research areas is the main aim of our staffing strategy.

Staffing and recruitment policy

Since 2014 we have had considerable success in recruiting new staff linked and in staff achieving promotion. We have invested in professorial staff (Kay, Whittaker) and in staff with specific research skills and expertise linked to our strategy for growth in particular areas, such as physical activity and health (Ryde, Connelly), neuromuscular physiology (Macgregor, Di Virgilio) and nutrition (Rodriguez-Sanchez). We have a strong record of nurturing staff, and through the Academic Advancement and Promotions process, several staff have been promoted during this REF period (three to Associate Professor and three to Senior Lecturer). This investment means we have professorial and associate professorial leadership in Behavioural Medicine/Psychology, Social Science, Nutrition and Physiology.

This submission comprises 27 staff - an increase of 5FTE over REF 2014, reflecting University investment in the restructured Faculty. This includes 10 ECR appointments made since 2016,

giving a staff profile of sixteen Lecturers, five Senior Lecturers, four Associate Professors, and two Professors. These appointments were driven by the Faculty's strategic plan to provide research leadership, and targeted recruitment of ECRs to fit within the foci of our three research groups and research domains.

Researchers are highly valued within our research community, and we have improved the stability of employment for researchers. Internal funding sources are available for 'bridge funding' to support the ongoing employment of staff between contracts which has ensured we are able to retain high quality researchers. During the COVID pandemic our agility has enabled us to continue to support researchers in a virtual environment, for example by sharing insights into interviewing participants using virtual systems.

Career development

Our review and appraisal framework, Achieving Success, was redesigned in 2016, when we created the Faculty of Health Sciences and Sport, to give greater priority to research targets, outputs and impact. A comprehensive induction programme sets objectives and support needs for each individual at the outset of their employment. All staff are then reviewed annually to reflect on their achievements and consider objectives for next year. There is an informal mid-year review of progress to encourage discussion and check in with progress. In this way staff are encouraged to identify the support they need to achieve their research targets. Staff on fixed-term appointments also undertake Achieving Success reviews and are encouraged to build a portfolio of research skills, expertise and experience in order that their skills can be utilised on research projects across the topic areas.

All staff on Teaching and Research contracts are provided with 40% of their time, through a workload allocation model, for research. In addition, staff are encouraged to apply for research leave, focussing on writing grant applications, papers, achieve impact and undertaking pilot work to support the submission of larger grants. Four staff members have had research leave (lasting between 6-12 months) between 2014 and 2020. Research leave was used for a variety of reasons including: (1) coordination of a large citizen science project with the BBC Terrific Scientific Team. The project, known as the Exercise Investigation, reached one third of UK primary schools and forms a key part of our Daily Mile impact case study; 2) for preparing ESRC and GCRF bids (Zambia) exploring menstrual health and sports participation in adolescent girls; 3) for completion of doctoral work on sport evaluation methodologies; and 4) for development of international sport doping research, impact and outputs.

Various supportive measures exist for staff development. These include annual staff assemblies; monthly research meetings; methods discussion groups; implementation science group; grant writing schemes; mentoring partnerships, both informal and formal; writing 'away' days; and collaboration in research projects. Staff are also supported to develop a wide range of international links, for example visiting or honorary researchers, and we have those established in the UK, United States, Canada, New Zealand, Australia, South Africa and Poland.

Financial support is provided for training and development, including networking. There are also a range of courses offered in the University coupled with the Staff Development Fund to support attendance at external training and conferences. Research staff are also supported through the Researcher Development Fund to help support grant-writing activities. Our Researcher Development Fund of £500/application was launched in 2017 to support research activities deemed to make a meaningful contribution to the university research strategy (e.g. travel to meet collaborators on a grant application).

ECR Development

Since 2014 we have appointed 10 early career researchers (ECRs). ECRs are on probation for 1-3 years, meaning that they receive support from a dedicated Senior Colleague, as well as annually review their research and teaching goals and achievements. To support research development and capacity building, teaching time is limited while ECRs are on probation;

specifically, teaching (normally 40% of total workload) is limited to ~20% of total workload in year 1, ~30% in year 2 and ~35% in year 3.

ECRs are represented at Faculty Research Committee. ECRs have their own committee with the Associate Dean of Research and Director of Research Development to raise important issues and promote career development actions such as the ECR network, mentoring, and Stirling Crucible. One successful example is Ryde who was connected to a senior research mentor in the faculty which resulted in her being awarded a Medical Research Scotland PhD studentship on Physical Activity in collaboration with a clothing industry partner.

2.2 Post Graduate Research (PGR) students

We promote an inclusive research culture where PGR students are integral and valued contributors to the research environment. We have a mix of full-time and part-time, on campus and distance learners, home and overseas students who have varied interdisciplinary backgrounds from sport science, sociology, psychology, physiology, physical activity and physiotherapy. This has generated a diverse and vibrant culture, with strong peer support. We currently have 44 registrations from the UK and overseas (including India, Malaysia, Italy, Botswana, and Saudi Arabia). Our postgraduate student numbers are therefore substantially greater than the previous REF period. From 2021, when all staff will have completed probation and be eligible to be primary supervisors, we aim to achieve the University target ratio of 2.0 PhD/FTE by 2024.

Our inclusive research culture fully integrates PGR students into our research community. Every student has membership of one of three research groups where they are fully integrated into meetings in order to obtain mentoring, support, and feedback on presentations, supplemented by additional PGR-focused structures and activities at Faculty and University level, e.g., PGR annual retreat, monthly seminars, guest speakers, online networking events, targeted training courses. PGR offices are located next to key areas of their work e.g. laboratories and/or relevant staff; each student has a well-equipped and spacious workspace within shared offices arranged so that junior PGR students share with more senior PGR students in similar disciplines, enabling peer mentorship and support. This further facilitates a positive culture of engagement. PGR students have staff-level access to all facilities and dedicated administrative support.

We offer two PGR pathways (PhD by publication or thesis), and PhD funding comes from a range of external funders, including Smartfish, Soccer PDP, Hibernian Football Club, **sportscotland** etc and internally, often through university-matched funded schemes, as well as some self-funded students. Since August 2014, there have been 26 PhD completions, a 70% increase on REF2014.

To top up external funding, and to address the financial constraints that can be experienced by overseas and self-funded students, a dedicated Postgraduate Research Support Fund is available of up to £800 per student, on application, to support additional training, fieldwork and conference expenses. Students have benefitted from this fund to present at international conferences (Cape Town, Berlin, London, Edinburgh) to attend advance training (conducting focus groups), and to assist with data analysis (interview transcription).

PGR students gain wider experience and participation in research through the following activities:

- A monthly seminar programme led by the students themselves and encouragement to attend Divisional, Faculty and University seminars and events;
- More formal bespoke training is delivered at three levels: i) by the relevant staff section, ii) through the University's dedicated Institute of Advanced Studies (IAS), and iii) via membership of the ESRC's Doctoral Training Centre in Scotland;
- PGR students are encouraged to identify training topics to suit their own needs that complement generic training available; these sessions are delivered by the relevant staff as required and are recorded and made available as podcasts;
- Students can register on modules from the postgraduate taught portfolio;

- An annual two-day residential retreat, providing further training, interdisciplinary collaboration, and a chance to socialise;
- The IAS offers central access to University induction and training, structured around employability and careers, IT, learning and teaching, and generic research skill;
- Membership of the ESRC's Doctoral Training centre in Scotland gives students access to advanced training at different institutions national;
- Students may attend bespoke external training/ career development opportunities such as the Scottish Government Internship Scheme from the Scottish Graduate School of Social Science where some students have been seconded for three months to Scottish Government.

Supervision for each PGR student is provided in teams of at least two supervisors (one of whom must be experienced) with complementary interests and disciplinary specialisations from across the University. All supervisors undergo full training and are required to complete an online course, comprising eight units representing all aspects of the supervisory process, with a further requirement for at least one further top-up training session per semester. Students meet with their supervisors at least monthly, in line with University-wide regulations, with progress and actions being recorded in an online log.

Annual progress appraisals are conducted by two independent members of academic staff, and separate pastoral care and support is available via the Director of Postgraduate Research. Student progression is monitored and governed via IAS. We encourage high-quality publishing at postgraduate level, to ensure that by the time of submission one or more papers is already in process. Students have opportunities to present their research within their staff sections, at the annual postgraduate retreat, through University-wide initiatives such as 3 Minute Thesis and at national and international conferences.

We offer our PGRs distinctive advanced training arising from our specific subject-related strengths and expertise. This includes impact-related activity drawing on our connections with sport agencies and industry, domestically and internationally. For example, in PENRG, advanced specialist training capitalises on expertise and facilities that support novel techniques. This has allowed the established researchers to pass their unique expertise to PGR students and post docs who have projects built around these techniques and associated equipment. This includes:

- high throughput transcriptomic studies (Affymetrix microarrays), including the wet lab techniques of high throughput transcriptomic;
- advanced statistical and bioinformatic analyses using R and python scripting languages;
- Bayesian statistical approaches as an alternative to frequentist approaches;
- high-throughput cutting edge molecular exercise research, supported by strategic grants and internal investment in equipment;
- muscle and adipose biopsy techniques to allow investigation of molecular changes in specific tissues;
- PENRG additionally send one PGR student annually to the Tsukuba Summer Institute, Japan where they attend a series of seminars and workshops to equip them with additional laboratory techniques and research skills;
- Stable isotopic tracer methodologies in metabolic research.

Evidence of our success in providing our PGRs with distinctive value-added training is demonstrated by career progression, including eight of our own PGRs obtaining full-time lectureship positions in UK universities (four of whom have been employed at Stirling) since 2014.

2.3 Postdoctoral Researchers

Postdoctoral staff are an integrated part of the wider ECR staff. We ensure postdoctoral staff are offered significant opportunities to develop their careers and to become full members of the academic community. Indeed, three prior postdoctoral researchers (Ryde, Macgregor and

Connelly) are now full members of academic staff. Postdoctoral staff are full members of individual research groups and internal funding is available to support conference attendance, pilot work, and impact events. Postdoctoral staff sit on research-related committees in the Faculty (e.g., the Research and Researcher's Development Committee) and are routinely involved in PGR supervision. Professional development activities available for all University of Stirling staff are also offered to postdoctoral researchers.

2.4 Technical Staff

Researchers are strongly supported by two experienced expert technical staff members. They are fully integrated into the SpHERE and Faculty community, attending research group and laboratory meetings, seminars, presentations, and social events. They assist with public engagement events including work shadowing by high school students, laboratory visits by primary school classes, and science fairs. They provide IT and software support for all disciplines, routinely support postgraduate and undergraduate students with the production of bespoke equipment, training in novel techniques and laboratory work supervision for some Honours student research dissertations. Technical staff are located within PENRG as they have responsibility for maintenance of the laboratories and are supported through regular meetings with the Director of Laboratories and the newly formed Technician Commitment that enables inter-university idea exchange. They are additionally encouraged to identify training and development opportunities or courses to enhance their technical expertise.

2.5 Equality and Diversity

University of Stirling has an Institutional Bronze Athena Swan award (September 2016) and colleagues are actively working towards a 2023 Silver Award. The Faculty of Health Sciences and Sport was awarded a Bronze award in May 2019 and has held Bronze awards since 2015, with plans to submit for Silver in 2022.

Led by a Sport researcher, the Faculty based Athena Swan group (consisting of staff and students) lead on monitoring equality and diversity across all areas of activity, supported by the University level executive committee. Equality is a standing item on all committee agendas. Evidence of success of our Equality and Diversity initiatives include:

- Within SpHERE, the percentage of female staff at professorial levels has risen from 31% to 100% and 67% of Senior Lecturer promotions were awarded to female staff during this REF period;
- In the Faculty, we funded and undertook a series of interviews (2018), to understand the ease with which staff felt they could get the family-related leave they need and how easy it was to return to work. Eleven staff had taken carer's leave most finding it a positive experience (91%, n=10). We have created a "family related leave" Champion who supports staff before, during and after all family-related leave.

All members of staff on promotion and interview panels are required to undertake the University's unconscious bias course. Gender representation (women to men) of research staff in our unit is 12 to 15 (ratio 1:25) (lecturer 8 to 10, senior lecturer 2 to 3, reader 0 to 4 and prof 2 to 0). This is better than the sector average (HESA 2018-2019 1115 to 1945 [ratio 1:74]) and we are making progress to increase women's representation. Monthly drop-in sessions across the Faculty are led by the Athena Swan team in order that staff can raise and discuss equality, diversity and inclusion issues.

All academic staff (regardless of contractual hours, gender or any other protected characteristics) are afforded considerable autonomy in flexible working and a 2018 survey suggested that an informal flexible working model was preferred by staff. For example, we operate in a family friendly environment and hold key meetings between 10.00am and 4.00pm to allow for attention to be given to other caring responsibilities.

Access to internal funding, such as the Staff Development Fund and the Conference Travel Fund, is monitored via our Equality and Diversity Action Plan by the Athena Swan group to ensure that there is equity across groups, including those with protected characteristics. We are committed to the AURORA Leadership development programme (Leadership Foundation for Higher Education) and two of our female academics have taken part in the programme.

The Faculty supports returning to work in a range of informal and formal ways. We ensure that the duties of women and men taking respective maternity/paternity/shared-parental or adoption leave are fully covered, including overlap periods pre- and post- leave to ease back to work transition, including keeping-in-touch days. We have various schemes to aid in the transition back to work including a period of protected research time. A University central fund covers replacement teaching for six months (pro rata) following return to work from maternity/shared maternity and adoption leave. This allows staff to have up to six months (pro rata) research leave on return to work. Indeed, a male member of PENRG was the first in the University to make use of new laws around shared-parental leave.

SpHERE has a strong record of internationality in its academic staff. Currently, a third of PENRG, SPARKLE, and S3RG staff originate from other global regions, including Europe (Netherlands, Italy, Denmark), North and South America (United States, Canada, Mexico, Brazil), Asia (South Korea), and Australasia (New Zealand).

Applications, success rate, and feedback from promotions committee are monitored for gender bias and other protected characteristics, and the application form enables applicants to identify circumstances the committee should be aware of (such as periods of extended absence, or significant responsibility outside academic work). We monitor unsuccessful grant applications to ensure additional support is provided to staff when applying for grants.

Access to internal funding, such as the Staff Development Fund and the Conference Travel Fund, are monitored via our Equality and Diversity Action Plan by the Athena Swan group to ensure that there is equity across groups, including those with protected characteristics, within the Faculty.

The University undertakes an anonymous staff survey every 3 years to gather staff attitudes and information on their health, well-being, and other needs. The survey is undertaken by an external agency to ensure full anonymity. Over successive surveys, we have seen improvements in those who feel part of a team and those who feel valued by colleagues, and an increase in survey results from those who "agree" that staff are treated on their merits irrespective of their gender (57% in 2018 v 39% in 2014, Faculty Health Sciences survey results). An action plan is prepared utilising the results of the survey and progress against it formally monitored.

Research leads from each of our Research Groups and the Associated Dean Research have formed a REF submission group with two-way communication to and from the group to all staff. This group have been responsible for developing the submission and communicating with staff about the submission. Our output policy asked staff to rate their own publications, and staff received feedback from external reviewers, on proposed output ratings, hence giving everyone the opportunity to input into the output process. Research Group leads and members of the Professoriate, were asked to give feedback on the environment statement to ensure it suitably captures the research environment. We discussed the submission openly at our annual research away days, giving all an opportunity to input verbally or in written format across the submission.

3. Income, infrastructure and facilities

3.1 Research Funding and Strategies for Generating Research Income

Prolonged University investment in Sport has ensured a significant strengthening of our research environment. Our strategy has resulted in an 89% growth of research income since 2014, securing £1,714,417 compared to £904,348 within the last REF period. Our mean average annual grant spend per staff FTE for this census period is £9,071 and will increase this year given our recent

awards. Prior to being submitted, all grant applications have rigorous internal peer review. Grant writing workshops are hosted by two professorial staff within the Faculty. These workshops support peer review and share learning, skills and methodological expertise.

We are particularly proud of our record of supporting new junior colleagues to embark upon funded research project portfolios. ECRs comprise 28% of our staff and it is notable that they have already had a number of successes in securing grants from significant funders, giving them necessary platforms for targeting future larger scale bids. For example, Wellcome (£23,567 and £7,320) and WADA (£42,583); IOC (£14,461.54) and Horizon 2020 (£56,384.72); ESPEN (£32,529.41); Nutricia Research Foundation (£60,000); Active Stirling Ltd (£5000), CSO (£106,845 CO-I and £52,289 CO-I), MRC (£98,482.00 CO-I); INNOVATE UK KTP (£269,761.00 CO-I) and; Anti-Doping Denmark (£23,826.83).

3.2 Organisational Infrastructure

Our organisational structures are designed to support collaboration, idea generation and research integrity. The research infrastructure supports all staff to produce high-quality research. In terms of organisation, research is supported by both a top-down and bottom-up approach. University Research Committee makes decisions, following consultation, about research strategy. The Associate Deans for Research, a key research leadership role within Faculties, are members of the University Research Committee and disseminate key information to the Faculty-level Research and Researcher Development Committee (RRDC). The RRDC, chaired by the Associate Dean for Research, oversees research development, monitors research activity, sets guidelines, evaluates performance, and reports on progress to Faculty Executive Committee and University Research Committee. Bottom up, the research sections meet at least monthly to nurture and support research activity. Academic staff are supported by Research and Innovation Services who dedicate staff to work with individual Faculties. These colleagues ensure a steady flow of information about research funding opportunities to staff, support RRDC, and the management of funded projects and administration of the Conference Travel Fund. Conference/event planning and organisation is provided by Professional Services staff within Faculties.

3.3 Research Laboratories and Facilities

We have well-maintained, extensive laboratory facilities comprising of:

- Ergometry or treadmill walking exercise modes;
- Body composition laboratory (with iDXA scanner, skinfold callipers, multi-frequency impedance analysis);
- Biopsy room / resting laboratory area with hospital bed enabling tissue sample collection (muscle or adipose) or prolonged resting (stable isotope tracer infusion studies);
- Resistance exercise laboratory (providing stimulus to examine skeletal muscle response to loading);

- Exercise Physiology laboratory (treadmill and cycle ergometry to provide stimulus to examine cardiorespiratory and metabolic responses to exercise using ECG and indirect calorimetry);
- Neuromuscular function laboratory with isokinetic dynamometer and intramuscular surface electromyography, including decomposition EMG, muscle stimulators,
- Nutrition laboratory (fully functioning kitchen to enable meal preparation for nutrition studies)

Since 2014 to enhance our laboratory facilities we have invested in:

- Cell culture laboratory (including two incubators, flow cabinet, and microscopy);
- Analytical laboratories (two laboratories housing multiple pieces of equipment such as microarray, qPCR machine, Luminex, cryostat, automated clinical chemistry analyser, plate reader and washer, gel electrophoresis and quantitative imaging equipment for analysis of proteins, equipment for radioactive sample handling and liquid scintillation counter, and Affymetric genechip instrument system). (Omega 3, microRNA for athlete phenotyping, protein synthesis research.)
- Teaching lab with 10 new work stations including Monark ergometers and AD instruments Powerlab which has been regularly used for research activities out with of teaching times (e.g., hydration research)
- Performance laboratory (to be used with SIS partners) which includes an analytical laboratory, physiology laboratory, strength and conditioning suite (strength and conditioning research) and a 40m 2 lane track (delayed opening due to Covid)
- Metabolic cart and Q-NRG for resting metabolic rate (carbohydrate dose response, Omega 3 etc research)
- Transcranial Magnetic Stimulator with dual coil (e.g., sport concussion research), and ultrasound and laser Doppler equipment for monitoring muscle architecture and blood flow responses to muscle (topical medicine research)



Figure 2. Investment in neuromuscular laboratory has led to high-profile impact on brain health and concussions, highlighted in BBC documentary 'Alan Shearer: Dementia, Football and Me'.

The University has invested £20m in upgrading and developing the campus sports centre facilities, which opened in 2020. These include a suite of High-Performance Laboratories, part of our shared space that facilitates our impact-generating collaboration with the sportscotland Institute of Sport. The University has also invested £200,000 in a new teaching laboratory for sport that also increases our overall research capacity, particularly for research performed by PGR students.

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

4.1 Arrangements for, and Effectiveness of, Research Collaborations

Our work is inter- and multidisciplinary and involves collaborations with UK and international colleagues. In 2014, we had a limited number of international collaborators, and a key strategic direction was to grow our international collaborations, reach, impact and reputation (Figure 3).

Examples noted below have been developed since 2014:

- In Europe, our researchers have been working with: 1) Uppsala University Sweden, Maastricht University, Netherlands on High Intensity Training research; 2) In Denmark with

University of Copenhagen and Aarhus University on antidoping policy research and; 3) Belgium at University of Leuven on sport leadership research;

- In North America, our researchers have been working with: 1) Duke University USA doing High Intensity Training research; 2) At Queens University, Kingston, Ontario, Canada, and Donald W. Reynolds Institute on Aging Arkansas, USA on Omega 3 and metabolic health research;
- In South America our researchers have been working with University of Sao Paulo, Brazil on hosting large scale sporting events;
- In Australia, our researchers collaborate with Deakin University, Geelong, and Griffith University on hydration and fluid balance research; and University of Melbourne researchers on stress psychophysiology;
- In South Africa, our researchers have been examining: i) sarcopenia in older township populations in collaboration with Universities of Cape Town and Witwatersrand and; ii) neuromuscular activation of trunk muscles during athletic strength training with University of Cape Town



Figure 3: Our worldwide map of collaborations of current projects and completed projects since 2014

4.2 Engagement and Impact with key research users and wider society

Our 'at the table' approach ensures our research (and research generally) is implemented into sport policy and practice. Our researchers contribute to relevant groups related to their research and its findings, and selected examples include:

- The Daily Mile Foundation Research Advisory Group, Scottish Government and Education Scotland, which facilitates the exchange of Daily Mile Research data and acts as an advisory group to governments and organisations seeking to implement Daily Mile initiative (Moran, Brookes);
- Our work with industry (e.g. Mentholatum, Glaxo Smith Kline,) achieved critical research outcomes that informed topical medicine and sports drink formulations. Making use of the Scottish Interface knowledge exchange programme scheme, we have been successful in leveraging a £5k start-up voucher into a 3-year Knowledge Transfer Partnership with the company SoccerDPD. (Macgregor);
- Our work with sportscotland, sportscotland Institute of Sport and UK Sport achieved coaching policy change through neural measurement to enhance elite athlete preparation

for competition. During this REF period sportscotland have provided us with two PhD students and one postdoctoral researcher (Hunter);

- The RaceClean program targeting amateur cyclists was developed from the USA Anti-doping Advisory Committee. Our active contribution to the committee based on our research findings was a key influence on the programme, (Dimeo, Henning).

Greater outreach work has engaged the University Communications teams to create policy briefings of our work that support greater penetration of our research into service domains. We communicate to our stakeholders through a variety of mechanisms such as: membership of advisory or working groups; dissemination workshops designed for encouraging discussion with stakeholders such as the public, patients, carers, health and social care professionals; feedback and (what next) service implications; parliamentary receptions; multi-media dissemination of Research and Policy Briefings, Newsletters; webinars; websites; publication in peer reviewed journals; contribution to clinical guidelines; and presentations and workshops at conferences.

4.3 Contributions to sustainability of the discipline

Beyond standard academic outlets, staff contribute their expertise more widely through participation on a variety of organisations and activities:

- On international and national sport organisations (USA Cycling; Anti-doping Denmark);
- On prestigious advisory panels and societies (American Psychosomatic Society; Daily Mile Expert Steering Group; Scottish Government Working Group on Supporter Involvement in Football Clubs; The International Society of Tensiomyography);
- On the development of practice advice and guidelines (Rugby for Life in Scottish Rugby; Scottish Youth Football Association on minimum heading of football in training);
- On community engagement events in relation to science (Pint of Science; BBC Terrific Scientific)
- On funding review panels for organisations (ESRC Panel A);
- On editorial boards (n=7); and,
- Provided 24 keynote speaker presentations since 2014.

In conclusion

Our research culture fosters an agile and dynamic research environment in which researchers work together on solving complex sport and health challenges facing today's societies to augment *Living Well*. Our research strategy strives to develop researchers who have the skill and ability to support innovative interdisciplinary research across the life course. Our researcher community ensures we respond effectively and timeously to diverse sport and health challenges to produce impact. Our onward research strategy is both responsive and innovative to ensure continued relevance to the sport, health, and exercise agenda which significantly contributes to Scotland's University for Sporting Excellence. We are continuously building capacity and capability within our team, with the end goal of delivering scientific and practical impact to society, people and performance.