Institution: Nottingham Trent University (NTU)

Unit of Assessment: C24 - Sport and Exercise Sciences, Leisure and Tourism

1. Unit context and structure, research and impact strategy

Unit Context and Structure

The Sport, Health and Performance Enhancement (SHAPE) Research Centre was launched in 2015 to provide a structured, supportive and vibrant research environment in which to investigate the biological, behavioural and societal impact of sport and exercise for human performance, health and well-being. Health and well-being is one of the five core NTU strategic research priorities and SHAPE has benefitted from an institutional investment of around £40M in infrastructure that has created a high-calibre physical environment for research. This includes c£34M for two buildings housing some of SHAPE's research laboratories. SHAPE was conceived with a strategic vision to promote and develop high-quality, multidisciplinary research across sport and exercise, which furthers understanding of individuals' lifestyles, human health and well-being across the lifespan. It delivers research that impacts positively upon health outcomes, performance in elite sporting clubs and teams, public policy making, product development and public engagement with science and research. The Centre aligns directly to REF Unit C24.

Since 2015, SHAPE has been central to the delivery of:

- an almost three-fold growth in research staff from 12.8 FTE (2014) to 33.4 FTE;
- a three-fold increase in the number of PhD students enrolled;
- a more than 5-fold increase in the income generated to support research;
- over 140 more peer-reviewed papers produced from NTU, from 58 papers in REF2014 to 202 in REF2021; and
- the development of a global portfolio of international collaborations, with, for example, the University of Sao Paulo in Brazil and the Education University of Hong Kong.

SHAPE developed from a Research Group of the same name (under the Biomedical, Life and Health Sciences Research Centre in REF2014) and is now one of four Research Centres within the School of Science and Technology (SST). SHAPE is directed by SALE who has overall responsibility for its management and strategic direction; he is supported by a Deputy Director (SUNDERLAND) and Research Group Heads (ELLIOTT-SALE, SHARPE, SUNDERLAND, WEEDON). Given the direct alignment of SHAPE with REF Unit C24, SALE also acts as Unit Coordinator, again supported by SUNDERLAND and an Advisory Group that includes the Head of the Department of Sport Science (NEVILL) and the Associate Dean for Research (ADR) of SST (McTERNAN). The Advisory Group helps determine strategic priorities and the utilisation and management of quality-related funds, striving to encourage multidisciplinary projects and dissemination. The SST Research Committee provides oversight of SHAPE activities, with reports provided on a quarterly basis. The ADR chairs a separate meeting for Unit Coordinators to provide School-level direction and, through membership of the University Research Committee and the University Leadership Team, a direct link between the Unit and the decision-making of the University.

The Director of SHAPE meets regularly with Research Group Heads to discuss research strategy and performance. Each Group has its own local objectives that tie directly into the overarching strategic aims of SHAPE. Staff from each Group are well represented in the outputs submitted for consideration to REF2021 and our three impact case studies come from three separate Groups.

The **Musculoskeletal Physiology Research Group (MSPRG)** investigates the effects of exercise and diet on the musculature and skeleton, under the leadership of ELLIOTT-SALE. The Group translates work that begins at the laboratory benchtop into the applied setting (*e.g.*, elite athletes, the general population, and patients) for improved training and performance or for the treatment and management of disease. Our research ranges from health-related work to elite

sports performance, covering topics including exercise physiology, nutrition, cellular and molecular biology, genetics and health. A major thrust of the Group's activity is the effect of exercise training, diet and nutrition on bone health in athletes and military personnel; work that underpins one of our impact case studies.

The **Exercise and Health Research Group (EHRG)** is led by SHARPE and explores the multitude of ways that sport, exercise and nutrition impacts human health and well-being, with a particular emphasis on the development of strategies and interventions. EHRG research focusses upon: the use of prebiotics and probiotics for health; amputees' gait biomechanics, mobility and prosthetic devices (underpinning another of our impact case studies); the interplay of exercise and nutrition and how they affect cognitive function; and respiratory physiology, with a particular emphasis on whether the work of breathing affects exercise tolerance and whether nutrition can reduce symptom severity and improve quality of life in asthmatics.

The **Sports Performance Research Group (SPRG)** led by SUNDERLAND completes multidisciplinary research to understand and improve cognitive and sporting performance across the lifespan, including: the identification of optimal methods of workload quantification to minimise time-loss incidence risk in elite sports teams; the impact of different modes, durations and types of exercise on cognitive performance; and aspects of the social environment in sport and physical activity to understand how those around us (coaches, parents, peers) can best support the child athlete. The Group's team sport research (underpinning another of our impact case studies) focusses upon enhancing performance in international and professional team sports.

The **Sport and Society Research Group (SASRG)** is a rapidly developing Group, led by WEEDON, comprising early career researchers (ECRs) publishing papers relating to the socio-cultural dimensions of sport, health and exercise. The Group is committed to socially relevant scholarship that impacts significant issues and debates across sociology, psychology and related fields. The Group connects research pertaining to diverse issues of violence, pollution, mental health, and gender discrimination, into real-world community initiatives, media communications and policy. The impact of this research, set out below, evidences a commitment to socially relevant scholarship.

Research and Impact Strategy

Strategic Aims and Achievements

SHAPE had four strategic aims for the current REF period:

1. To impact positively upon performance and health through the delivery of high-quality services and consultancy that are underpinned by our excellent research;
2. To increase the number of research-active staff within an inclusive and sustainable research environment;
3. To increase research excellence, as evidenced by an increase in the average quality of our research outputs; and
4. To increase our national and international reputation.

These aims have been achieved as a result of investment in infrastructure and people, and a strategic focus upon developing our profile through a national and international research dissemination strategy to emphasise the Centre's placement, prominence and eminence in its areas of expertise. In doing this, SHAPE has maintained a focus upon equality and diversity. Some of our major achievements are:

1. Significant planned and targeted growth: expanding our staff base from 12.8 FTE in REF2014 to 33.4 FTE with a significant responsibility for research, providing evidence of a strong research environment and a sustainable platform upon which to base future research activities;
2. A focus upon promoting equality and diversity: 41% of our staff with a significant responsibility for research are women and 97% of our staff believe that the University is committed to equality of opportunity (results from the most recent staff survey, with an 82%

response rate). In October 2020, the Department of Sport Science received an Athena SWAN Bronze Award;

3. A 532% increase (from £191,973 to £1,020,927) in the income generated to support research compared to REF2014 (see Section 3), evidencing an upward trajectory in external research income. This is accelerating, with over two-thirds of the total income spend (£690,902) occurring in the last two years of the REF cycle. SHAPE has also received more significant grant awards (*e.g.*, £940,677 from the UK MOD and over £200,000 from the Football Association) than in REF2014;
4. Research activity and output production has increased since REF2014, with over 140 more papers produced from NTU (Scopus) during the current REF cycle. SHAPE has increased the visibility and impact of its research by successfully publishing in high profile multidisciplinary journals, including *PNAS* and *Nature Communications*;
5. A significant increase in international collaborations (see 'collaboration' in Section 4 for details): 45% of the papers produced from NTU involved international collaborators, compared with just 19% in REF2014 (Scopus);
6. SHAPE now has collaborations with researchers at institutions in over 20 different countries (*e.g.*, University of British Columbia, Brock University, Jönköping University, University of Limerick, Education University of Hong Kong), demonstrating our growing reputation outside of the UK;
7. A large increase in the number of charity (*e.g.*, Rethink Mental Illness) and industry (*e.g.*, HUUB Design) collaborators, demonstrating our growing reputation beyond academia. For example, HUUB Design is funding and using SHAPE research to develop clothing solutions for elite endurance athletes and SHAPE researchers sit on the Rethink Mental Illness Physical Activity steering group, which assesses and develops a Sport England funded project to improve metal health through physical activity;
8. A strong pipeline of doctoral research, with 40 PhD students having Directors of Studies from the Unit at the REF2021 census date;
9. Generation of a high calibre research environment, SHAPE has benefitted from a significant investment in infrastructure (around £40M) and equipment (over £1M) and through strategic investment of our quality-related funds (c£472,692);
10. The development of a Sport Performance Analysis Service, which helps to deliver real-world impact from our research.

Facilitating Interdisciplinary Research and Impact

It was identified early on in the REF cycle that interdisciplinary working was an important enabler to the development of a sustainable research environment and to increasing research excellence, as per our strategic aims. SHAPE has supported its researchers in developing collaborative interdisciplinary projects with colleagues across SST in the John van Geest Cancer Research Centre, Biosciences, Chemistry, Engineering and Physics; these have come to fruition, for example, in the form of PhD studentships from NTU funds and in project funds from two of the University Research Priorities (Health and Wellbeing, and Medical Technologies and Advanced Materials). This has contributed significantly to the 11 PhD students that involve or have involved SHAPE researchers on inter-departmental supervisory teams. Significant cross-fertilisation of ideas also takes place at various research-focussed events across SST, such as the School of Science and Technology Research Conference, Research Centre seminars, training events and research showcases.

SHAPE, as part of its impact strategy (our first and foremost strategic aim), is committed to developing closer links with industry and sports organisations, coaches, practitioners and the general public. In recognition of the importance of developing impact in our research, SHAPE established an Impact Group (Chaired by ELLIOTT-SALE and MORRIS) tasked with embedding impact in our research projects. Development of SHAPE's impact strategy has been supported by NTU's significantly expanded Research Operations and Research Development and Knowledge Exchange offices. They have invested in workshops on impact that have allowed more focussed impact generation and knowledge exchange, which has contributed to changes in policy and practice for the stakeholders in our research. SHAPE's links with industry have been strengthened

by support for 50:50 funded PhD studentships through the University's match-funding scheme, which provides joint funding along with an external funder. SHAPE has been awarded matched studentships with the English Institute of Sport, The Waterloo Foundation, HUUB and Natural Alternatives International, representing an internal investment of c£120,000.

MSPRG, EHRG and SPRG have all produced impactful research that is showcased in an impact case study, providing evidence of end-user engagement with industry (*e.g.*, Blatchford Ltd) and with sports organisations (*e.g.*, English Institute of Sport, Football Association), practitioners (including performance nutritionists, physiologists, clinicians), athletes and the general public (*e.g.*, amputees). SHAPE has made use of its Academic Associate programme to underpin impact case studies and to increase the amount of impactful research being conducted beyond the current REF cycle. Through quality-related funds, SHAPE has supported impact case study leads with an Academic Associate who have helped to identify, record and evidence the impact generated from our research (using 50% of their time), whilst also conducting their own research in these areas (using 50% of their time). SASRG's research, whilst not showcased in an impact case study, is highly socially relevant and helps to shape policy governance (*e.g.*, England Boxing), garner media exposure (*e.g.*, Canadian Broadcasting Company, The Conversation, The Irish Examiner) and support community initiatives (*e.g.*, Love Fighting Hate Violence, Think Football), which provides evidence of a commitment to socially relevant scholarship. We have introduced a Sport Performance Analysis Service to provide sports science support to all, from recreational athletes to Olympians. SHAPE's BASES and BPS accredited staff run workshops, individual and team testing sessions and screening and provide training prescription, as well as tailored multidisciplinary support sessions, that are underpinned by SHAPE's Sport Performance Research providing direct impact to end-users.

Further examples of the successful development of working relationships and the success of SHAPE's approach to research dissemination through the media that have enabled and facilitated impact are reported in Section 4.

Open Access and Data Management
NTU Publication Policy mandates the deposit of the full text of journal articles in our institutional repository, which enables the sharing of research outputs and underlying data. For further support, a centrally managed open access fund was established in 2014 to increase our ability to provide immediate open access to outputs via the gold route. Within the Unit, this fund has supported around 20 publications since 2014, with immediate open access amounting to a total expenditure of circa £30K (see *REF5a*). The NTU Library has agreed publisher deals that have allowed corresponding authors from SHAPE to publish via the gold route, off-set against subscription costs (see *REF5a*). Our Research Data Management Policy ensures that research data are managed to the highest standards throughout the research data lifecycle and encourages researchers to make their data openly accessible to the maximum extent possible. A centrally managed storage service for research data provides a secure environment for personal, sensitive and confidential data, while the Arkivum client ensures the preservation and long-term archiving of datasets. NTU has a Research Data Management Officer, who provides advice and support on GDPR and safe and secure data archiving.

Research Integrity
Matters relating to research integrity, including research ethics, are overseen centrally and managed locally. The University Research Committee, chaired by the Deputy Vice-Chancellor – Research and Enterprise, and reporting to the Academic Board, is responsible for the development and monitoring of research integrity policies and procedures. The University Research Integrity Committee (URIC; SALE and NEVILL from SHAPE sit on this Committee) provides support and advice to Research Centres. Systems are in place to ensure research projects requiring ethical approval are robustly scrutinised; SHAPE research is supported by the activities of the Human (invasive) Ethics Committee (Chaired by SALE) and a Non-Invasive Ethics Committee (Chaired by NEVILL). Both committees report to URIC.

Future Strategic Aims

SHAPE intends to build upon the successful implementation of our current research strategy to ensure the long-term viability of our research environment. It will remain our vision to conduct multidisciplinary research at the highest level across the sport and exercise sciences in order to influence and impact human health and well-being. Our intention is to apply the knowledge from our research to techniques and tools that address the performance, health and well-being needs of individuals and populations. SHAPE will focus upon increasing its international reputation and the production of world-leading research with high impact, based upon the following aims:

1. **To be recognised for our world-leading research and an interdisciplinary research environment** – SHAPE will strategically invest in infrastructure and equipment to make sure that researchers have access to resources at the forefront of latest developments. This will include making use of internal collaborations to enhance our research capability (*e.g.*, collaborating with colleagues in the John van Geest Cancer Research Centre to access their GeoMX™ Digital Spatial Profiler to perform spatial transcriptomics). SHAPE intends to expand interdisciplinary research, underpinned by significant University investment in initiatives like the Medical Technologies Innovation Facility (opened at the end of 2020), which is intended as a key impact and commercialisation vehicle for cross-disciplinary research;
2. **Develop academic and industrial partnerships and promote civic engagement to increase the impact of our research** – SHAPE will work with internal support structures, including our new Strategic Partnership Manager, to develop current or new relationships with external organisations that will add significant value and enable us to demonstrate better the benefits of our research to industry, sports organisations, athletes, coaches, practitioners and the general public. SHAPE will remain committed to preparing athletes for competition at the highest level but also to the realisation of a healthier society, with a view to addressing key questions and grand challenges (*e.g.*, the ageing society);
3. **To increase the number and productivity of our international collaborations** – SHAPE will direct resources towards forging deeper international links to increase our reputation for world-leading research and expand the reach of our impact. Lessons learned from strong current collaborations (see Section 4) will be leveraged to develop a greater portfolio of international research links, with, for example, countries like Israel, Canada and the USA;
4. **To develop the work of the Sport and Society Research Group** – with a focus upon social justice within and across sports and exercise, to connect the Group's current research on social, economic and environmental equality;
5. **Promote, retain and recruit high-quality, research-focussed staff at all levels** – given its high proportion of early career researchers (ECRs), SHAPE will focus upon supporting their development towards research leadership through a focussed mentorship programme that will be targeted towards individual requirements, as identified in individual research plans (IRPs). Recruitment strategies will focus upon alignment to Research Groups, with a clear commitment to promoting equality, diversity and inclusion (focussing upon an Athena SWAN silver award application).

2. People

SHAPE Staffing Strategy

Our recruitment strategy has been to seek out and appoint high quality staff who align with the aims of our Research Centre and Groups. SHAPE has recruited those who are, or have the potential to become, outstanding internationally recognised researchers, even if they are early career at the time of appointment. This strategy has been very successful; appointed ECRs have been promoted to associate professor (COOPER, SARKAR) or have been awarded grants as PI (*e.g.*, VARLEY, HEALY). Several of our appointed staff (*e.g.*, NEVILL, WEEDON, SARKAR, FAULKNER, CLAYTON) have received awards relating to their work (see Section 4).

This strategy is critical to our success, especially given that SHAPE has been through a period of significant growth since REF2014, almost tripling in size and expanding its senior staff base. This growth includes the recruitment of 1 professor (NEVILL), 7 mid-career researchers, and 18ECRs. SHAPE also recruited an independent research fellow (SANTOS) and a research technician. The ECRS were distributed between the groups to ensure they would be fully supported to develop their research expertise. For example, eight appointments were made into the SPRG to increase the interdisciplinary nature of the group and four ECR appointments were made into the SSRG to drive a developing research focus in Sport Sociology.

Underpinning our significant growth is the fact that SHAPE has retained the majority of its staff who contributed to the REF2014 submission, with only four of them having left the University. Our impressive staff retention is evidence of a supportive research environment that is underpinned by our commitment to recognise the achievements of our staff through promotion. One member of staff was promoted to full professor (SALE) and five to associate professor (ELLIOTT-SALE, COOPER, MORRIS, SUNDERLAND, SARKAR). Eight members of staff have transitioned from Lecturer to Senior Lecturer (BARNETT, HEALY, JAMES, SARKAR, SAWARD, VARLEY, WEEDON, JOHNSTON). Four of SHAPE's former PhD students (BISELE, SAWARD, VARLEY, WILLIAMS) have been awarded permanent academic positions.

Staff Development

NTU has developed a more structured and transparent approach to the allocation of research time during the REF cycle to support staff with the delivery of high-quality research. IRPs form part of the workload planning process, providing allocated time for staff to focus upon research. IRPs are used to support staff to deliver at the requisite level based upon research outputs, impact generation and research grant capture (whilst remaining cognisant of career stage and equality and diversity characteristics). This performance-based approach to research-time allowances has led to the sustained increase in the quality and quantity of outputs.

Postdoctoral staff are actively supported in their transition to academic posts (either within SHAPE or elsewhere). Research staff are managed within the University's appraisal framework, which involves regular career development meetings with senior academics. They can also take Careers and Employability Service courses to assist with career planning. The transition of our independent research fellow (SANTOS) to a full academic career is supported by a phased transition into a permanent lectureship, which is complemented by the provision of internal research funds enabling SANTOS to apply for and manage research grants and to experience sandpit style funding models. She is part of a wider SST network of independent research fellows who provide peer support and benefit from training and development.

Early career academic staff benefit from reduced teaching and administrative loads. ECRs are allocated at least 500 hours per year of protected research time on their academic workload, with a further 300 hours per year allocated to training and development. Start-up money (up to £4,000 per person) has been provided to our new starters and ECRs to assist the purchase of small equipment items (*e.g.*, physical activity monitors) or consumables (*e.g.*, assay kits). ECRs are encouraged to apply for internal research funds to provide capacity and equipment for external research grant applications. Research studentships are awarded to ECRs in association with more experienced staff who can act as a mentor. These mentors also guide: the development of IRPs; work at the international level; and applications for external research funding. Senior research staff are also encouraged to include ECRs on internal applications for research studentships, meaning that the ECR gains valuable experience in the supervision process. Apart from one newly appointed ECR, all are currently involved on PhD supervisory teams. ECRs are encouraged to attend and present at the SHAPE Research Centre Seminar Series, which allows them to practice the dissemination of their own research and observe and engage with world renowned researchers. Evidence of the impact of this support is that several of our ECRs (*e.g.*, CLAYTON, PIASECKI, VARLEY, HEALY, DOIG, APPS) have received external research grant funding (totalling over £175,000) from the British Nutrition Foundation, the Physiological Society,

the British Milers Club, the Football Association, the British Academy, Rethink Mental Illness, the Society for Endocrinology and Li-Ning Company Limited.

All academic staff have biannual performance review meetings with a senior academic to make strategic plans for the coming year and to select relevant staff development opportunities. Research accomplishments are celebrated and promoted via the Vice-Chancellor's Annual Researcher Awards and two of our ECRs (FAULKNER, COOPER) have been the recipients of these awards. Quality-related funds devolved to SHAPE (c£472,692 has been spent between August 2014 and July 2020) are used for staff development to sustain existing research strengths and to underpin new developments through the provision of research studentships (*e.g.*, the Academic Associate programme), journal publication costs, continued professional development courses, conference travel and sabbaticals (JOHNSON, BARNETT).

Research Students

SHAPE attaches great importance to its PhD programme and our postgraduate student community is core to our research environment. Professional Doctorate degrees are not offered. 100% of our PhD students (n = 13), who completed their PhD programmes, did so within 4 years (full-time) or 8 years (part time), demonstrating the success of our recruitment, training and progression-monitoring activities. In the Postgraduate Research Experience Survey in 2019, the overall satisfaction in SST was 84%, which is 3% higher than the sector. Even more impressive was the 92% overall satisfaction reported by PhD students from SHAPE. There is an even stronger pipeline of doctoral research coming through, with some 40 PhD students having Directors of Studies from the Unit at the REF2021 census date. A key enabler of this healthy forward-looking trajectory in research student numbers has been the development of an Academic Associate programme whereby the research student completes their PhD research on a part-time basis, whilst also being employed to support teaching or impact activities, thus developing additional skills at the same time.

SHAPE has diversified its doctoral funding award portfolio to include charities (*e.g.*, The Waterloo Foundation, £35,462), industry (*e.g.*, Manchester City Services Limited, £72,158; Bristol Rugby Club, £72,159) and other institutions (*e.g.*, University College Birmingham and Birmingham City University, total £14,637). Internal investment has also been important, with SHAPE having received 13 NTU Vice-Chancellor Scholarship awards since 2014. The University's match-funding scheme is a particularly important avenue for PhD research student support, as it provides joint funding along with an external funder. The external funder becomes a full partner in the research, benefitting from access to expert staff at the University and fresh new talent. The Unit and the PhD student benefit from pursuing collaborative research with real-world relevance and interactions with expert external researchers/practitioners.

SHAPE invests heavily in the development and success of its postgraduates by, among other things, providing quality training, consumables money, and financial support to attend conferences to present their work (SHAPE supports attendance at one national and one international conference). Our success in this regard is perhaps best evidenced by the fact that our postgraduate researchers are highly employable (*e.g.*, as practitioners with the English Institute of Sport, as university lecturers, and as postdoctoral researchers). Interdisciplinary PhD projects are strongly encouraged and supported, and SHAPE has around ten students who are co-supervised with NTU colleagues from across biosciences, engineering, physics, social sciences and psychology. SHAPE staff are also active supervisors on PhD programmes at other universities (*e.g.*, Liverpool John Moores University, Loughborough University, Canterbury Christchurch University, Northumbria University, Manchester Metropolitan University, University of Limerick). Through our doctoral training alliance, researchers in SHAPE (SANTOS, SALE, WILLIAMS) lead on two projects alongside NTU colleagues and collaborators from Liverpool John Moores University, Manchester Metropolitan University, the University of Southampton and the University of Reading.

Our postgraduate student community is supported by the NTU Doctoral School and School Postgraduate Research Tutor (ELLIOTT-SALE from SHAPE is the Postgraduate Research Tutor

for SST). The NTU Doctoral School has responsibility for overseeing admissions and the registration, progression-monitoring and examination of PhD students.

Training and Support

SHAPE provides a supportive research environment to help students reach their full potential; supervisory teams consist of at least two University staff. Academic staff must attend a Doctoral School training course within twelve months of commencing their first research student supervision. All research students participate in a rolling programme of professional development through the Doctorate Plus Programme (DPP), designed to empower students to create an individualised package of activities to support them through their PhD journey. The wide range of workshops and activities available maps to the Vitae Researcher Development Framework and all PhD students undertake training in research methods, data management and knowledge transfer through courses provided by the Doctoral School as part of the DPP. This is supplemented by specialised workshops and seminars in research practice that are run by our Postgraduate Research Tutor and ADR (*e.g.*, statistics, ethics and research integrity, project management, appointment and interview processes, and equality and diversity awareness). For international students where English is not their first language, English classes are provided. Subject-specific training is undertaken by supervisory teams and generic skills training is provided throughout the programme. There is support for the dissemination of their research, which includes presenting a conference poster at the Science and Technology Annual Research Conference in the second year of studies. Final year students present at the SHAPE Research Seminar series. The strength of our training and support is evidenced by the fact that our students have won awards at major conferences (*e.g.*, PAPAGEORGIOU won two awards at the American College of Sports Medicine [ACSM] Conference in 2016 and TOWNSEND won the Best Oral Presentation award at the Bone Research Society Meeting in 2016).

Progress Monitoring

The Doctoral School has carefully designed, implemented and audited quality control procedures for monitoring the progress of PhD students. Research student programmes are formally monitored on a six-monthly basis. This can include a panel meeting with supervisors and an independent assessor, who acts as an independent third party, providing input into the design and progress of the PhD programme.

Supporting and Promoting Equality and Diversity

NTU has a strong commitment to equality and diversity (see REF5a) as evidenced by the recent (April 2019) Athena SWAN Bronze Award. As part of the four-year action plan to improve gender balance, the University is committed to increasing female representation among the professoriate to 35% by 2022, as well as investing in the NTU Cohort Aurora Programme, designed to address the under-representation of women in leadership positions across the sector. Each School has an Athena SWAN Champion who leads efforts in addressing local challenges in relation to gender equality and associated intersectionality. SST recognises that staff training improves knowledge and understanding of equality and diversity and it has introduced essential unconscious bias training for all staff. Across all academic and research staff in SST, 32% identify as women (28% in 2014), 16% identify as Black Asian and Minority Ethnic (13% in 2014), and 4% declared with a disability (4% in 2014) in 2019. As part of its commitment to advancing equality, diversion and inclusion, NTU has:

- Developed the Support of Academic Returners (SOAR) scheme to support colleagues returning to academia following a period of caring-related leave;
- Actively monitored diversity in all governance committees;
- Ensured all meetings take place between the core hours of 10am and 4pm;
- Taken a flexible and inclusive approach to staff working from home where possible.

SHAPE abides by and is committed to each of these policies and initiatives.

SHAPE is a vibrant place to research, enriched by the diversity of perspectives, cultures and backgrounds brought by its students, staff, visitors, local communities, and national and

international collaborators. In October 2016, a Self-Assessment Team was established within the Department of Sport Science (from where the majority of SHAPE Researchers come) to promote equality and diversity and prepare for the Athena SWAN Bronze Award. This was received in October 2020, reflecting efforts to promote gender equality and to identify and address challenges particular to the discipline.

A culture of equality and diversity underpins the SHAPE ethos and is encouraged through ensuring the gender balance of seminar speakers, celebrating key events (such as Black History Month and International Women's Day), ensuring that our commitment to equality and diversity is included in job advertisements and including Athena SWAN as a standing agenda item at staff meetings. The Department of Sport Science implements NTU maternity and adoption leave policies, which follow best practice and legal compliance. In SHAPE, 14 of our 34 staff (33.4 FTE) with a significant responsibility for research are women, equating to around 41% or our staff research base. 50% of our professors and 40% of our associate professors are women, representing a good proportion of our senior staff base. Three staff members returning from maternity leave have received between £2,500 and £5,000 from the SOAR scheme to support career pathway development and have also benefitted from a lower teaching timetable for 12 months in order to aid in the recommencement of research.

The results of our most recent staff survey, with a response rate of 82%, showed that 97% of staff in the Department of Sport Science believe that the University is committed to equality of opportunity for all of its staff. 100% report that they do not feel harassed or bullied at work. The vast majority of our staff also report that the University acts fairly, regardless of protected characteristics, with regards to recruitment (100%), progression and promotion (90%) and development opportunities (94%). Similarly, between 97% and 100% of our staff also report that the University respects people equally regardless of age, disability, gender reassignment, sex, sexual orientation, race or religious belief.

SHAPE's REF submission and output portfolio were developed in accordance with the institutional code of practice. Category A staff were advised about the window for the voluntary declaration of Individual Staff Circumstances, and the University's Head of Equality, Diversity, Inclusion and Wellbeing provided a question-and-answer session and debrief to explain the process, how it works, how reductions work, and emphasising that the process was voluntary.

3. Income, infrastructure and facilities

Income

SHAPE research has been supported by a significant upward trajectory in funding; income spend has grown from £191,973 in REF2014 to £1,020,927 in the current REF period; this evidences sustained growth, particularly given that the spend for RAE2008 was £7,575. The *income* spend within the current REF cycle is accelerating, with over two-thirds of the total (£690,902) spent in the last two years. SHAPE also has over £500,000 of awarded funding carrying over into the next REF cycle. SHAPE has received awards from an array of funders, with a spend of £806,163 from UK industry, £133,019 from UK central government, £47,036 from UK based charities and £10,539 from overseas industry.

SHAPE's significant successes include a major grant award (total £940,677) from the UK Ministry of Defence (SALE, ELLIOTT-SALE) to support the work of the Women in Ground Close Combat Team in determining the efficacy of a physical development programme to enable servicewomen to better return to the physical demands of their job following pregnancy. Evidence-based postpartum physical training is urgently needed to prepare servicewomen for their safe return to physically arduous roles. The PERFORM study has been designed to restore physical function after childbirth and enable servicewomen to achieve their physical employment standards upon return to duty. Subject to organisational endorsement, these findings will be implemented through improved training and rehabilitation policies and will be shared with stakeholder communities across defence (Women's Health Advisory Group, Women's Health Rehabilitation Steering

Group), and wider occupational and athletic communities. Our work in this area is also supported by funding from the Nottingham and Nottinghamshire Clinical Commissioning Group (£63,000) to complete projects relating to maternal obesity in the local population (ELLIOTT-SALE, SALE). Taken together, it is anticipated that this work will form the basis of a future impact case study around female activity and health.

SHAPE's research on improving team sports performance and reducing the incidence of major injuries has been supported by the award of over £210,000 of funding from Manchester City Services Limited, Bristol Rugby Club and the Football Association (MORRIS, NEVILL, SUNDERLAND, COOPER, VARLEY). This research has changed policy and practice relating to youth talent identification and development, training load prescription, monitoring and data management and analysis.

SHAPE has also been supported by the English Institute of Sport (SALE, ELLIOTT-SALE) for work relating to the bone health of athletes and by a US company, Natural Alternatives International (SALE, ELLIOTT-SALE, DOIG), for our work on the potential therapeutic actions of carnosine. This work laid the foundations for the development of partnerships that will allow us to sustain the longer-term impact of our work beyond single studies. Some of this work has allowed us to promote interdisciplinary research across SST (*e.g.*, the work on carnosine funded by Natural Alternatives International has the potential to develop from a microbiological approach through to human studies).

Our ECRs have been successful in attaining external funding for research (e.g., WILLIAMS from the Physiological Society, CLAYTON from the British Nutrition Foundation, PIASECKI from the British Milers Club and HEALY from Rethink Mental Illness). SHAPE has also received 'in kind' research support, including the provision of supplements for our ergogenic aids research, scanning equipment to support our bone and ligament research and garments to support our compression garment work.

Infrastructure

SHAPE is supported by a comprehensive research infrastructure. The University Research Operations and Research Development and Knowledge Exchange offices support SHAPE with grant writing and submission and both pre- and post-award administration. The Doctoral School supports SHAPE with everything related to doctoral programmes. The University's library infrastructure provides subject-specific staff for SHAPE who manage our open access institutional repository (iREP) and support/train staff with resource management activities. The NTU Digital Technologies Team provides support for computing and information technology, including the provision of specific software and hardware and training relating to their deployment.

Facilities

The University has continued a high level of investment in the physical infrastructure relating to SHAPE research activities and our doctoral community. There has been c£34M worth of investment in two new buildings utilised by SHAPE.

The Interdisciplinary Science and Technology Centre (ISTeC) has a state-of-the-art biochemistry laboratory, exercise physiology laboratory, nutrition suite and food laboratory. The development of the ISTeC laboratories has facilitated interdisciplinary research, given that it houses research from several Centres. For example, using these laboratories, collaborations between researchers in C24 (SALE, DOIG) and A03 (TURNER) have examined the potential therapeutic actions of carnosine.

The Engineering building, which incorporates human factors and sports engineering, and houses a state-of-the-art environmental chamber, has helped to foster multidisciplinary research collaborations between exercise physiologists (FAULKNER and GRIGGS, submitted to C24) and electronic (HUGHES-RILEY and DIAS, submitted to D32) and mechanical (SIEGKAS, submitted

to B12) engineers. These collaborations have helped to develop new systems for monitoring, modelling and improving human function in both sports and health sectors.

The University has invested in the refurbishment of SHAPE facilities, including an additional biomechanics laboratory (c£372,000), a repurposed exercise physiology laboratory (c£28,000) and a new psychology laboratory (c£80,000). SHAPE has benefitted from c£3.2M investment in sporting facilities that provide space and equipment for research. These include: a new artificial 3G pitch and associated facilities (c£1.57M) that supports our footwear and team sports research; a new Tennis Centre (c£1.1M) that has provided a safe isolated space for our paediatric health and performance research; and upgraded strength and conditioning facilities (c£550,000) that support training studies.

Our two biomechanics laboratories house motion capture systems and both ground embedded and portable force plates. These systems have mobile EMG, accelerometery and insole pressure measurement systems, complemented by software packages for musculoskeletal modelling, simulation and statistical analysis. They underpin a wide range of our research activities, including those relating to amputee gait and sporting footwear.

Our sport and exercise psychology laboratory allows quantitative and qualitative research to be conducted. The new laboratory provides space for interviews and focus groups and equipment for effective transcription (*e.g.*, Dragon software) and data analysis (*e.g.*, NVivo on laptops). It enables researchers to investigate, understand and improve the performance and learning of complex, dynamic skills across a range of domains and to perform in-depth investigations into the skills that underpin performance, including perceptual-cognitive (anticipation and decision making) and motor skills, and the relationship between perception and action. Cognitive booths enable participants to complete cognitive tasks requiring self-control with no distractions.

Our scanning laboratory encompasses dual x-ray absorptiometry (DXA) and peripheral quantitative computed tomography machines for the determination of body composition and bone mass and strength. The laboratory also includes a GnRB arthrometer for the measurement of ligament laxity. These machines are used extensively for our exercise, diet and musculoskeletal research. When combined with our new collaborative capabilities in MRI (capital investment of c£0.5M), SHAPE has a powerful core capability for musculoskeletal imagery relating to the effects of exercise and diet on the musculoskeletal system.

Our four exercise physiology research laboratories are equipped with a range of ergometers, expired air analysis systems and blood analysers. Each laboratory incorporates specific equipment for its primary research use: 1) paediatric exercise physiology; 2) respiratory physiology; 3) exercise performance; and 4) health physiology. The exercise performance laboratory incorporates ultrasound, combined functional near infra-red spectroscopy (NIRS), electroencephalogram (EEG), thermal imaging, neuromuscular dynamometry with electrical and magnetic stimulators and a breath-by-breath expired air system. The health physiology laboratory includes all equipment for the assessment of anthropometry, as well as an isokinetic dynamometer and purpose-built dynamometers for neuromuscular assessments. The respiratory laboratory incorporates breath-by-breath systems and equipment for the measurement of respiratory pressures – using gastric and oesophageal balloon catheters linked to pressure transducers for a wider data acquisition system. Using this approach, work done by the diaphragm, rib cage muscles and abdomen can be measured. “Volitional” pressures at rest and during exercise can be measured, as well as “evoked” trans-diaphragm pressures, using magnetic stimulation of the phrenic nerve.

SHAPE has a second environmental chamber that is British Olympic Association accredited and allows the manipulation of temperature, humidity and oxygen levels for physiological, nutritional, psychological and health research.

The Nutrition Lounge and associated kitchen provides a purpose-built area for nutrition research and a relaxing environment for participants. It encompasses cognitive function booths for the assessment of the impacts of nutrition and exercise on cognitive function in children, adolescents and adults.

Our exercise biochemistry laboratory contains equipment to determine the basic biochemical responses to exercise and diet and also includes tissue culture facilities. SHAPE also accesses collaborative core facilities across SST including, but not limited to, flow cytometry, high performance liquid chromatography, mass spectrometry and OMICS capabilities.

To support the continued growth and operation of these facilities, SHAPE has benefitted from an investment of over £1M on equipment since 2014. This includes isokinetic dynamometers, exercise ergometers, MRI (part-bid), DXA, FlexCell and cell culture equipment, instrumented treadmill, new Qualisys camera system, force plates, two breath by breath gas analysers, ultrasound, a thermal imaging camera, a global positioning system, Firstbeat heart rate systems, a NIRS system and EEG.

SHAPE has supported (totalling £155,218 from quality-related funds) the running costs of research, primarily for PhD students and ECRs. These costs largely relate to laboratory consumable costs, blood collection equipment, transcription services, publication and open access costs and travel/accommodation to support field studies. This also includes investment in smaller items of equipment including Actiheart5 systems for exercise metabolism studies, video cameras, dictaphones, transcription software, accelerometers, ergometers, laptops to run cognitive function tests and small items of equipment for the cell culture.

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

In line with two of its key strategic aims, SHAPE has focused upon 1) developing our national and international reputation and 2) impacting upon performance and health through the delivery of high-quality services and consultancy, underpinned by our excellent research. A key to this has been developing the number and quality of our national and international collaborations, which has been achieved through a research dissemination strategy, supported by funds for conference attendance and international collaborator visits. In order to expand the impact of our research, SHAPE has encouraged, through informal discussion and the staff appraisal process, the development of closer links with industry and charities to allow direct exploitation of our research. Below are some of the key achievements:

Collaboration

SHAPE has active collaborations locally, nationally and with countries on five continents. Our collaborations now extend to over twenty countries worldwide, including: Australia, Austria, Belgium, Brazil, Canada, China, Egypt, Germany, Hong Kong, Ireland, Italy, Japan, Malaysia, the Netherlands, Portugal, Qatar, Spain, Sweden, United Kingdom, United States,

Significant international collaborations include:

- SALE and ELLIOTT-SALE collaborate with the Applied Physiology and Nutrition Group at the University of Sao Paulo, Brazil (since 2010). This collaboration has expanded significantly during the current REF cycle, with four successful grants held in Brazil; SALE was awarded a Science Without Borders grant to visit Brazil for six weeks each year for three years. SALE and ELLIOTT-SALE have been supported by Santander travel grants and have participated in teaching activities at USP. The collaboration has yielded over 20 peer-reviewed papers.
- SALE has started collaboration with the University of Limerick (Ireland) and the Sport Ireland Institute on a PhD project funded by the Irish Research Council, relating to the impact of low carbohydrate diets on bone health and (re)modelling in elite endurance athletes.

- BARNETT collaborates with the Department of Rehabilitation at Jönköping University, Sweden (since 2013). This has included collaboration on research grants held in Sweden and the US, along with Erasmus supported periods of collaborative teaching and research in Sweden and the UK. The collaboration has resulted in three publications and international conference presentations.
- WEEDON collaborates with Professor Brian Wilson at the University of British Columbia, Canada (since 2015). This collaboration relates to studies about sport journalism, which has yielded two high-quality papers.
- SUNDERLAND collaborates with Associate Professor Amr Hassan at Mansoura University, Egypt (since 2019), which has resulted in the publication of two innovative papers incorporating advanced data analytical techniques including machine learning.
- COOPER, MORRIS, SUNDERLAND and NEVILL collaborate with Dr Sun Fenghua, at the Education University of Hong Kong (since 2015). This involved working on collaborative grant applications to the Hong Kong Government Research Fund. COOPER visited the Education University of Hong Kong in February 2017. This collaboration resulted in four joint grant applications, two peer reviewed journal articles and one invited book chapter.

SHAPE researchers collaborate with academics at over 20 institutions across the UK. For example, ELLIOTT-SALE collaborates with Liverpool John Moores University on a project, funded by the Racing Foundation, relating to the identification and development of key physical and health characteristics of jockeys. SHAPE researchers collaborate with eight other Departments (Biosciences, van Geest Cancer Research Centre, Law, Psychology, Physics and Maths, Animal, Equine and Veterinary Sciences, Engineering, Sociology) across NTU, which is particularly encouraged through a programme of events and activities related to the NTU Research Priorities. For example, COOPER is collaborating with colleagues across NTU on a project titled “Small Steps, Big Changes Evaluation project’, which was funded by the Nottingham City Care Partnerships (£931,376).

Contribution to Research Base

Editorial Board Membership:

Our academics have held 20 positions on editorial boards during the current REF cycle, including: Journal of Sports Sciences (SUNDERLAND), European Journal of Sports Science (SALE), Frontiers in Sports Nutrition (SALE), Frontiers in Physiology (SUNDERLAND), Frontiers in Sports and Active Living (MORRIS), PLoS One (SUNDERLAND), Nutrition and Health (SALE, ELLIOTT-SALE), BMC Musculoskeletal Disorders (PIASECKI), Prosthetics and Orthotics International (BARNETT), Psychology of Sport and Exercise (SARKAR), International Journal of Sport and Exercise Psychology (SARKAR), Sensors (SUNDERLAND, MALCOLM, MAGISTRO), Journal of Sport Psychology in Action (SARKAR) and European Journal of Applied Physiology (ELLIOTT-SALE).

Grant Reviewing:

Our staff have reviewed grants for National and International awarding bodies. Examples include: Medical Research Council (SALE, CLAYTON), Biotechnology and Biological Sciences Research Council (SALE, JAMES), Engineering and Physical Sciences Research Council (BARNETT), Economic and Social Research Centre (SUNDERLAND), The Knowledge Foundation (SUNDERLAND), Rosetrees Trust (SALE), Wellcome Trust (SALE, BOAT), Dunhill Medical Trust (SALE), National Osteoporosis Society (SALE), British Heart Foundation (COOPER), Physiological Society (SUNDERLAND), National Science Centre (Poland) (SALE), Natural Sciences and Engineering Research Council of Canada (SALE).

Conference Organisation and Attendance:

Our staff have attended over 200 national and international conferences. SALE has been an organiser of five Highlighted Symposia and two Tutorial Lectures at ACSM Annual Meetings since 2014 and was on the International Scientific Committee of the International Congress on Carnosine and Anserine in 2014 (Tokyo, Japan) and 2017 (Louisville, Kentucky, US). SARKAR

organised the BASES Psychology Division Day Conference at NTU (May, 2018) and NEVILL organised the BASES Sport Performance Division Day Conference at NTU (May, 2018).

Invited and Keynote Talks:
SHAPE staff are regularly invited to give talks and keynote presentations at National and International scientific meetings. For example, SARKAR has given keynote talks at the Netherlands Olympic Committee National Coach Platform; WEEDON gave an invited talk to the European Association for the Sociology of Sport Conference (Bo, Norway, 2019); FELTON gave a keynote presentation to the World Congress of Science and Medicine in Cricket (Loughborough, UK, 2019); SALE gave the Roger Harris Honorary Keynote Lecture at the 15th Annual Meeting of the International Society of Sports Nutrition (Clearwater Beach, USA, 2018); ELLIOTT-SALE gave a keynote lecture at the iSHARE conference on Female Athlete Health and Performance (Montreal, Canada, 2019).

Contributions to Professional Associations and Learned Societies, Fellowships and Awards:
In 2019, NEVILL was awarded an OBE for services to sport and sports science. SHAPE researchers have made important contributions to professional associations: SALE is a Fellow of ACSM and Chair of the ACSM BONE Interest Group. He also sat on the ACSM Membership Committee, reviews abstracts and is a judge for the GSSI travel award at ACSM Annual Meetings. SALE is the nutrition editor for the BASES magazine (The Sport and Exercise Scientist) and participated in the 2019 GSSI XP as an expert panel member, giving a talk on "Nutrition for Athlete Bone Health". SUNDERLAND is a Fellow of BASES. SUNDERLAND and NEVILL review abstracts for the BASES annual meeting. SUNDERLAND is a reviewer for BASES Accreditation (sports science support and research) and is the network representative for The Physiological Society and BASES. PIASECKI sits on the early career steering group of the Society of Endocrinology and on the affiliate working group of the Physiological Society.

WEEDON won the Young Researcher Award from the European Association for the Sociology of Sport (2019) and FELTON was awarded the best paper by a new investigator at the International Society of Biomechanics in Sport (2017). SARKAR won the BPS division of sport and exercise psychology PhD award (2015) and the Association for Applied Sport Psychology Dorothy V. Harris Memorial Award in 2020. APPS won the best poster award at the 13th Footwear Biomechanics Symposium (2017) and FAULKNER has received an American Physiological Society select award. CLAYTON won the GSSI/ACSM Young Investigator Award (2015) and the Nutrition Society Postgraduate Competition (2015). SHAPE researchers have authored four BASES Expert Statements relating to 'Conducting and Implementing Female Athlete-Based Research' (ELLIOTT-SALE), 'Extracellular Buffering Agents' (SALE), 'Interventions for improving performance in the heat' (SUNDERLAND) and 'The Role of Breakfast-Physical Activity Interactions for Energy Balance and Metabolic Health' (CLAYTON).

Contributions to Economy and Society
Coach and Practitioner Development and Education
A central approach of the Unit's impact strategy (our leading strategic aim) is to embed research into sporting practice through partnership with sports organisations, coaches and practitioners. Within elite sport, FELTON runs coach education programmes for the English Cricket Board focused upon the development of fast bowling technique to improve performance and reduce injury.

Others have been involved with coach education in football, Olympic committees and professional sport. For example, SARKAR helped to develop coach and practitioner education and professional development guidance relating to the cultivation of resilience in individuals, teams and organisations that include the Talented Athlete Scholarship Scheme, the US Olympic Committee, the Netherlands Olympic Committee, the Football Association and the Premier League.

HUNTER has provided coach education sessions to the FA Women's High-Performance Centre around nutritional strategies to support elite football performance. HEALY has worked with the same group on promoting mental health and well-being. ELLIOTT-SALE sits on the Football

Association Scientific Advisory Group for the development of Women's Football; the group's remit is to develop women's football from grassroots participation through to elite performance.

MATTHEWS has run research translation days for coaches, practitioners and academics to inform practice on the empowerment of women through combat sport participation. This was used by UNESCO in their work on martial arts and combat sports, including the production of an educational resource (Women in Combat Fighting, Empowering Female Coaches). MATTHEWS has contributed to the development of a coach education toolkit around the idea of "Love Fighting, Hate Violence". This translates research on this topic into a campaign to raise awareness of the important moral difference between sport-based combat and violence. It encourages practitioners and fans of martial arts and combat sports to reflect upon this distinction and to encourage various forms of anti-violence action. SARKAR was invited by the Centre for Research and Evidence on Security Threats to provide a session on "performance and coping under extreme stress" that focused upon lessons for security and law enforcement practitioners; this was written up as a report and published as an article in its magazine.

Youth Development
SHAPE researchers focus upon the effects of exercise and physical activity on the physical and psychological development of young people. For example, COOPER, SUNDERLAND, MORRIS and NEVILL have completed research with schools across the UK that has resulted in the implementation of physical activity programmes to develop health and cognitive performance. SAWARD, MORRIS, NEVILL and SUNDERLAND have been working with elite football academies and international hockey development squads on systems for talent identification and players' physical and psychological development.

Product Design and Development with Industry
HUUB Design is commissioning and utilising research by FAULKNER to develop clothing solutions for elite endurance athletes. These clothing solutions include fabric development and treatments to influence thermal conductivity by improving sweat evaporation and performance. This also includes other clothing and equipment developments for elite triathletes to reduce hydrodynamic and aerodynamic drag, to increase athletes' efficiency and improve performance. FAULKNER has been integral to the development of a new wheel set with improved aerodynamics for elite cyclists with Parcours, which resulted from collaboration on a research project to better understand the distribution of yaw during outdoor cycling and how this impacted upon design requirements of bicycle wheels. APPS has conducted research alongside footwear manufacturers (*e.g.*, Li Ning (China) Sports Good Co. Ltd) to provide information on how footwear construction influences foot movement, which links to the improvement of footwear design for performance, comfort and reduced injury risk. SHAPE researchers have engaged with industrial partners to improve their products; examples include the development of a climbing training tool, product testing on recovery gels and garments and the efficacy of dietary supplements for performance and health (*e.g.*, beta-alanine, prebiotics).

Impact on the General Population
SHAPE, as part of a University-wide initiative, runs several outreach activities aimed at engaging school age children and young people with higher education and research. For example, SHAPE runs the High-Five programme, which is aimed at school pupils in Year 5 who come onto campus and explore basic physiological responses to exercise, including muscle activation and kinematic analyses during jumping. SHAPE also runs the Active-Eight programme, aimed at school pupils in Year 8, who come to the campus overnight to experience university life and also explore wider elements of sport science, such as motor control, nutrition and footwear biomechanics. The Aim Higher programme is provided for pupils in Years 11 and 12 who come from areas of low socioeconomic status for a Sport Science taster day at the University. They experience a sample lecture followed by a practical session (usually standard physiological responses to exercise) and some basic analyses of their findings. These sessions were delivered to around 300 pupils from 10-12 different schools. VARLEY and PIASECKI went to the Royal Society to deliver a session to over 300 children and parents on bone adaptations to space flight and how exercise is important

to the maintenance of bone mass, as part of the Physiological Society's outreach event on space physiology and the Mars mission. VARLEY runs sessions for local lower league professional football clubs (Mansfield Town and Peterborough United), whereby students from the University administer a battery of field-based tests aimed at assessing football specific performance. This had the dual benefit of providing an affordable service to these local clubs and provided some much-needed real-world experience for our students. In line with this, SHAPE provides students with the opportunity to gain experience with local sporting clubs (*e.g.*, Nottinghamshire Cricket, Nottingham Rugby, Nottingham Forest FC), who also benefit from sports science support.

SHAPE researchers sit on a number of charity and parliamentary steering groups. For example, COOPER sits on the Nottingham City Childhood Obesity Forum, with Councillors, public health professionals and a representative from the Small Steps, Big Change project. Their aim is to identify factors influencing childhood obesity in Nottingham and to produce a plan to tackle the increasing prevalence of obesity in young people. HUNTER has advised parliamentarians to help them establish a new All-Party Parliamentary Group (APPG) on the Human Gut Microbiome, with the aims: "*to highlight the role of the gut microbiome in physical and mental health and its capacity to prevent many disorders and improve or slow others; to inform debate about how this will save money for the Treasury and NHS; and to enable communications between interested parties and relevant parliamentarians*". HUNTER has been given honorary membership of the APPG and is its honorary Scientific and Research Adviser. HEALY sits on a Mental Health Through Sport Partnership steering group, which aims to use the mobilisation of the Commonwealth Games (as part of its legacy) to promote and improve mental health and well-being of people in the West Midlands through a series of symposia and workshops. HEALY also sits on the Rethink Mental Illness Physical Activity steering group, which assesses and develops a Sport England funded project to improve metal health through physical activity.

Media and Dissemination
SHAPE researchers invest a significant amount of time on the dissemination of their research to non-academic audiences. For example, VARLEY appeared on BBC Radio 5 Live to talk about genetic predisposition to injury and sporting prowess (May 2018). This was picked up by ABC radio in Australia. Our researchers have written over 15 articles for The Conversation that have reached several million readers, with the three articles penned by CLAYTON on intermittent fasting being particularly popular, having a total of well over 1M reads. The Conversation articles relating to 'What do athletes actually eat?', 'What supplements do scientists use, and why?' and 'Winter Olympics: why many athletes will be struggling with asthma' penned by WILLIAMS have also been extremely popular with over 780,000 reads; some of these articles were also featured in the mainstream media.

Our researchers have been prominent across the BBC in the last academic year, with FAULKNER appearing on BBC 2's Trust Me I'm a Doctor, giving his expert view on whether hot or cold drinks are better at cooling us down. PIASECKI appeared on BBC Radio 5 Live discussing her research relating to the starting age of master athletes. SARKAR appeared on BBC Radio 5 Live talking about mental health in elite sport and the psychological impact of retirement. ELLIOTT-SALE featured on BBC Sport providing her expert views on the effect of the oral contraceptive pill on female athlete performance.