Research Institute for Sport and Exercise Sciences (RISES)

1997-2017: CELEBRATING 20 YEARS OF WORLD-LEADING RESEARCH





Delivering world-class research and applied solutions in sport and exercise sciences



About the Research Institute for Sport and Exercise Sciences

The Research Institute for Sport and Exercise Sciences (RISES) was established in 1997 and continues to be the cutting-edge and vibrant home of research activity within the School of Sport and Exercise Sciences at Liverpool John Moores University (LJMU). The Research Institute is a world-class environment at the forefront of developments that advance understanding in sport and exercise science through world-leading research in biomechanics, brain and behaviour, cardiovascular health, exercise metabolism and adaptation, physical activity and sport psychology and development.



Research Excellence Framework 2014: Top for Research Quality in the UK

Twenty years after its establishment, RISES is now the top UK institution for research quality in sport and exercise sciences. The Institute has been ranked first in the Research Excellence Framework (REF) 2014 in UoA26 based on Research Quality Index data, with 97% of our total research activity rated world-leading or internationally excellent*.

Our REF 2014 highlights also include the largest volume of world-leading research papers amongst all submissions in UoA 26 with 60 outputs rated at 4*. We were one of only three departments in sport and exercise sciences which had 100% of its research environment rated world-leading (4*). The majority (90%) of impact activity was rated at 4*.

Our Impact Strategy Document and Impact Case Studies were determined by the REF 2014 panel to be world-leading examples of outstanding impact from a mature, well-managed and visionary supporting environment. We achieved an exceptional grade point average (GPA) of 3.57, with 62% of all research activity being ranked as 4*. This places RISES as the 11th best academic department in the country out of the 1,911 submissions to REF 2014, RISES was also ranked the top department with the highest GPA score in any subject amongst all post-92 institutions.

Ranking of the World Universities: 6th Best Department in the World

In the first ever Academic Ranking of World Universities (ARWU: 2016) for the sports sciences subject area, LJMU's School of Sport and Exercise Sciences was named the sixth best department in the world amongst 400 worldwide sport-related units that actively engage in research in this field. The School is also ranked the third best in Europe, highlighting our global research influence. Through ShanghaiRanking, the official publisher of the ARWU, this was the first ranking system designed to discover world-class research within institutions with a subject focus on sport sciences.

The School achieved these results following a rigorous ranking system based on measurement of various indicators between 2011-15, which included volume of publications, total citations, citations per publication, volume of publications in the top 25% journals according to their impact factor and the percentage of publications with international collaborations. We are particularly proud of our international collaborations and it was very pleasing to see this strong pillar of our research environment reflected in the highest score by far (80%) for publications with international co-authorship amongst any of the top 10 institutions in the world.

For further information visit: www.researchprofessional.com/media/pdf/UoA26_Sport_Exercise.pdf www.shanghairanking.com/Special-Focus-Institution-Ranking/Sport-Science-Schools-and-Departments-2016.html

RISES Research Groups and Exchanges

RISES is the home of broad-based, multidisciplinary, fundamental and applied research in sport and exercise science. Our staff interrogate the 'exercise response' from the cell to the community; from the elite athlete to multiple clinical groups; and from the youngest to the oldest members of society. Research activity is organised and overseen by five discipline-specific research groups and two multi-disciplinary thematic research exchanges.

Biomechanics

Work is underpinned by excellence in fundamental research, leading to applications in clinical and sport and exercise biomechanics through collaboration locally, nationally and internationally. Research foci include sports biomechanics, ageing and biomechanics of stair negotiation, musculoskeletal growth and development, musculoskeletal adaptations to chronic use, disuse, disease and ageing, footwear biomechanics, postural stability and advanced statistics and data analysis techniques in biomechanics.

Musculoskeletal modelling approaches are used for improving performance, reducing loading and preventing injuries. Muscletendon function and joint kinematics are examined in-vivo using ultrasonic imaging and videofluoroscopy for estimation of joint loading for injury prevention and effective rehabilitation. Clinical Biomechanics themes include movement/gait analysis in Alkaptonuria, Cerebral palsy and Stroke, Artificial Neural Networks applications in cerebral palsy gait and shoulder pathology and Virtual Rehabilitation applications in cerebral palsy, scleroderma and TBI.



Developing understanding from the neural level through to perception and cognition, and culminating in the final human motor behaviour. The Brain and Behaviour Research Group has staff with a range of complementary skills and experience that collaborate on two broad and related research themes, namely sensorimotor neuroscience and expert performance and learning.

Our research on sensorimotor neuroscience seeks to better understand the processes involved in typical and atypical human motor behaviour (e.g. autism spectrum condition and stroke patients), with the intention to facilitate the individual's interaction within their surrounds.

Our goal in expert performance and learning is to improve the performance, training and learning of complex, dynamic tasks and domains through research, education and applied solutions. Expert performers are required to carry out the work in most domains including sport, and we seek to optimise the acquisition of expert performance in different domains using research evidence and cutting-edge technology.





Cardiovascular Health

The Cardiovascular Health Sciences group works within state-of-the-art facilities and collaborates with world-leading laboratories to perform cutting-edge research on the biology and physiology of the cardiovascular system. Our main areas of expertise and research focus are cardiac and vascular function and structure in sport, health and disease. We pioneered and developed cardiac and vascular screening protocols to help identify those at risk of sudden cardiac death and improve the cardiovascular care of athletes in the UK and globally. We also examine a range of lifestyles from highly active (elite) endurance athletes to those with sedentary behaviours and/or the presence of cardiovascular disease. The clinical and societal importance of this research is particularly important given our contemporary lifestyle, which is characterised by physical inactivity.

Engagement in physical activity and exercise training is the only highly effective strategy. Our shared commitment is to understand the impact of physical activity and inactivity on the cardiovascular system and the importance of exercise training for promoting and maintaining cardiovascular and cardiorespiratory health and the prevention of cardiovascular diseases. There is clear cross-over and interaction within the research group that promotes an understanding of the cardiovascular system from the sub-cellular level all the way to whole body responses to physical activity.



Exercise Metabolism and Adaptation

The Exercise Metabolism and Adaptation Research Group (EMARG) investigates how skeletal muscle adapts to acute exercise and sustained training. This research is applicable to the design of interventions to improve human health, wellbeing, recovery and sporting performance. The group has three research theme groups: human performance; exercise and human health and cellular and molecular mechanisms contributing to performance and human health. This work is supported using a variety of relevant models and methods, including: molecular technology, adult human stem cells, proteomics, cutting edge microscopy and human in vivo training and nutrition studies. All of these aim to improve functional adaptation.

Our research examines how scheduling of exercise, nutrition and supplementation, ageing, injury, drug use and genetic variation affect the rate and the extent of muscle adaptations. We examine the cellular mechanisms of adaptation by investigating how individual muscle cells adapt their behaviour following changes in activity and environment. Our research is therefore directly applicable to the design of interventions to improve human health, wellbeing, recovery and sporting performance for everyone.

Psychology and Development

We promote positive change in identity, performance and wellbeing. We work with professional sports teams, Olympic athletes and UK institutes of sport in the areas of identity, culture and personal meaning in elite sport, and how this informs the development of athletes, coaches, and sport science support staff and practitioners. We implement and evaluate interventions promoting positive changes to player, coach, support staff and sport science practitioner identity, performance and wellbeing, both during and after their sport-related careers.

We examine the daily existence of athletes, coaches and associated support staff and how they understand themselves and others within the environments they are striving to master using a wide range of cutting-edge, multidisciplinary scientific approaches. The research team are interested in how sporting environments influence people's identities and psychological development, along with how sport can be used to help people enhance performance, develop as individuals and improve the quality of their lives. We explore how the elite sport culture informs effective sport science and sport psychology service delivery and how practitioners working in this context can be developed within their professional training and thus our research findings impact policy and practice in applied settings.





RISES Exchanges

To capitalise on key alliances in health and sport performance, RISES took the strategic decision to supplement its research group-focused structure with two themed 'Exchanges' in 2010-11. The Football Exchange and the Physical Activity Exchange are unique in the UK and produce high-quality applied research that is translational. They have been identified as good practice in the sector. The two themed Exchanges are externally oriented with a focus on developing mutually beneficial partnerships with industry, end-users and other stakeholders of our research. These two themes match specific areas of staff expertise, consultancy, service delivery and funding opportunities, as well as facilitating and providing opportunities for us to demonstrate our external impact through the translation of our research for the benefit of end-users.





The Football Exchange

The Football Exchange (FEx) is a multidisciplinary group whose mission is to deliver high quality and innovative support to the football industry through world-class research, high-quality education and applied enterprise solutions. The FEx has led the way in fostering a scientific approach towards the training, preparation and development of players, coaches and teams in elite level professional football.

We are working with a range of high profile partners including: the Premier League, The FA and other football governing bodies, key sports industry companies such as Nike, Prozone/Stats and top football clubs such as Liverpool, Everton, Manchester United and Read Madrid. FEx's areas of work include the physiology of preparation and performance, match analysis and data analytics, psychology of human behaviour, psychology of skill and expertise, performance and injury prevention biomechanics, performance nutrition and education in football science and coaching. FEx's research has changed how elite clubs manage the preparation and recovery of their players in addition to being at the centre of the developments of game changing performance analysis techniques. We have also developed formal academic training and continuing professional development courses for key staff and coaches from around the world and organised the first worldwide science and football conference as part of the efforts to transfer knowledge across the global 'football family'.

The Physical Activity Exchange

The mission of the Physical Activity Exchange (PAEx) is to benefit public health by delivering world-class research and applied solutions for the promotion of physical activity and fitness and the reduction of sedentary behaviour. It is committed to worldclass science for promoting innovation, research capacity and output in the field of exercise and health and to the investigation of the positive effects that sport and exercise sciences can have on our communities (e.g. local, national and international). The PAEx is spearheading the Impact Agenda in physical activity by developing key relationships with local government, health, education and industrial partners. It is translating research evidence to impact policy and practice. Its members offer support to professionals, organisations and commissioners from a broad range of sectors, including health, sport, leisure and recreation, education and transport.



Research impact and public engagement

RISES embraces our University's moral and civic responsibility to translate our world-leading research and practice to our local, national and international communities. To extend the reach and significance of sport and exercise sciences in the UK, we have embedded public engagement activity within our mission statement and core activities. We are committed to public engagement and the translation of high-level work to a range of diverse populations. This work allows us to demonstrate the positive impact that sport and exercise sciences can have on our communities at the local, national and international level.

Face to Face with Sport Science



Face to Face with Sport Science (F2FSS) is our public engagement interface. Our award-winning F2FSS team have exhibited on site, at local and national museums, academic conferences, schools, hospitals and community events. Included in these activities are: Radio 5 national projects/ initiatives such as Radio 5's Big Sporting Day Out, Sport Relief and Universities UK. LJMU is also a signatory of the National Co-ordinating Centre for Public Engagement Manifesto.

The prestigious external funding received for our public engagement work from the Wellcome Trust Engagement Award, Podium Award 2012 and Royal Society Grants are further markers of innovation and excellence in public engagement.

Global Active City programme

Our work with the Liverpool City Council on developing and evaluating an 'Active City' programme (2005-present) has been recognised as a model of best practice by the International Olympic Committee (IOC). The Global Active City Development programme was launched to expand this initiative to other cities around the globe. The project is led by TAFISA (International Sport for All) in partnership with Evaleo (Sustainable Health Organisation), the IOC, LJMU and Liverpool Active City. In conjunction with Liverpool City Council, we are involved in setting standards for cities to be accredited by the IOC on the basis of their strategic approach to their own physical activity provision engaging education, health, government, industry and charitable partners.

External partnerships

Our work has provided additional benefits to other external partners, including: English Institute of Sport, UK Sport, British Olympic Association, British Shooting, English Cricket Board, British Snowboard and Skiing, Munster Rugby Union, St. Helens Rugby League, elite boxers, professional jockeys and a range of support programmes to individual Olympic and Paralympic athletes. Impact has resulted in direct improvements in performance and education, player preparation and recovery, nutrition and development of new technology and improved training policies.

We hosted the Office of the World Commission for Sport Science (2003-2012) which disseminated the latest developments and practice across a range of sports. Finally, we financially support and (co)deliver with industrial partners, national and international training courses in ultrasound technology (GE), performance analysis (Prozone) and biomechanics (Qualisys and C-Motion).



RISES people and collaborations

The main role of RISES is to provide structures, support, critical mass and a focus for all of the research work being undertaken in LJMU's School of Sport and Exercise Sciences and to provide a clear link to teaching and enterprise. In this way, world-leading research clearly informs and infuses the curriculum, underpins applied work and enhances our civic responsibility. There has been a significant investment in the recruitment of world-leading academics and early career researchers with tremendous promise and potential through the LJMU 'Inspire Initiative'. RISES currently includes over 60 academic staff, along with a number of post-doctoral fellows, 138 PhD students, five technical staff, two research officers/assistants, three administrative staff and a number of Honorary and Visiting Professors and Researchers, working together in a research-led environment.

Excellent multi- and inter-disciplinary research networks exist within RISES and extend to world-leading national and international collaborations. The RISES Board, chaired by the Head of RISES, oversees the strategic research direction of the School, providing lines of communication to the research groups and themes as well as to the School Management Team. These world-leading staff and facilities underpin quantitative and qualitative evidence of excellence in our Research, Impact and Public Engagement.

We have met the multiple challenges of developing novel, cutting-edge curricula that produce work-ready graduates, world-class research that is mechanistic but impactful, as well as developing dissemination strategies that transfer knowledge to the communities we serve. The University has recognised our strategic agenda and achievements as pre-eminent in our field and rightly identified us as a **"Beacon of Excellence"**. With our history of vision, strategic planning and active connections to local, national and international partners, we exemplify the University's mission statement to be a **"Modern Civic University"**.

This dynamic academic culture empowers staff and enables the training of postgraduate research students in world-class facilities. We currently have over 130 PhD research students in RISES and we led the development of a University-wide postgraduate student professional development and teaching programme.

The '3i's' programme is offered to students alongside their research work to help them prepare for the variety of teaching, assessment and administration challenges of an academic career. Formal postgraduate links with Malaysia, Thailand, as well developing ties with Australia and The Netherlands, make a significant contribution to the University's 'Internationalisation Strategy'. Our international collaborations, highly cited journal outputs and grant funding had a direct impact on the University being ranked in the top 100 World Universities under the age of 50 and, more recently, being named the 6th best Sport Science department in the world.

Since 2010, our staff have co-authored publications with colleagues from >330 external organisations, of which more than 65% are international. This internationally situated work has resulted in >4,000 citations with an average of 8.3 citations per publication, which is well above the discipline average.



World-class research facilities and infrastructure

RISES is housed in LJMU's £29 million Tom Reilly Building. Its purpose-built infrastructure includes state-of-the-art laboratories and equipment, and world class facilities for understanding human performance and behaviour. This iconic building and unique facility is named after the late Professor Tom Reilly who was the UK's first Professor of Sport Science and the 'Father of the Science of Football'. Tom Reilly is recognised as the person responsible for forging the rich heritage of sport and exercise scientific study at Liverpool John Moores University, the UK and beyond.

The investment in bespoke sport science laboratories and latest technologies was reinforced by the refurbishment of the adjacent Max Perutz Life Sciences Building in 2013 at a cost of £8.5 million. The facility houses exceptional, new laboratories for biochemical, biomolecular and stem cell biology, as well as imaging facilities. The co-location of these laboratories allows the interrogation of the exercise response in an integrative manner within a contained, world-class infrastructure from the molecular to the whole-body level, and is unique in the domain of sport and exercise science in the UK and the world. This infrastructure provides an exciting platform from which to investigate emerging exercise and health issues and thereby sustain future world-leading scholarship.

Generic research space

Our generic research space includes two large general exercise physiology laboratories (with multiple ergometers and metabolic analysis systems), two muscle function laboratories (muscle stimulation and dynamometry), two environmental chambers (-20 to 50°C with normobaric hypoxia capability to simulate an altitude of 4500 m), a body composition laboratory (skinfold, impedance and DEXA) a recovery laboratory (hot and cold water immersion) and a range of small clinical rooms (blood sampling, biopsy). Research Groups and Exchanges also manage and quality control scholarly activity in bespoke facilities.

Biomechanics Research Group Laboratories

The Biomechanics Research Group Laboratories are equipped for the study of fundamental, sport and clinical human biomechanics from the muscle-tendon level, in vivo, to whole body locomotion. Two large research laboratories and a 70 metre runway are equipped with four optoelectronic motion capture systems with multiple cameras and force platforms, plantar pressure measurement systems, wireless electromyography and Xsens inertial sensors to allow complex movement analysis. A further laboratory houses a CAREN virtual reality system, including a large display screen, a computer driven motion platform with integrated Kistler force plate, a Vicon MX system and EMG. This laboratory also has a unique, custom-made staircase instrumented with independent Kistler force plates. These tools are integrated to study posture and balance in the context of cerebral palsy, as well as muscle function during activities of daily living such as stair negotiation and to help prevent falls and accidents on stairs through individualised training. The mechanical and structural properties of the human musculoskeletal system are also examined using isokinetic dynamometry and ultrasound imaging.

Brain and Behaviour Research Group Laboratories

The three co-located, purpose-built Brain and Behaviour laboratories allow for studies of: i) gait and balance, interceptive actions and perception-action coupling using life-size projected displays with fullbody kinematic data collection systems (Vicon Bonita, Qualisys QTM) and visual search technologies (Mobile Eye or Tobii glasses), as well as Nike Inc. SPARQ Sensory Station with Vapor Strobe Eyewear providing visual assessments for high performance sport; ii) oculomotor control using a full black-out facility and control room with two-way mirror integrated with eye movement analysis by video-oculography (Eyelink100) integrated with motion analysis systems (Vicon Nexus or Ascension trakSTAR); iii) sensorimotor neuroscience and neural plasticity using transcranial magnetic stimulation (Magstim BiStim) and electrical (tDCS) stimulation integrated with motor evoked potentials (DelSys Bagnoli) and limb kinematics (Optotrak Investigator) and iv) sensorimotor learning and imitation via a suite containing computers with linked displays, digitising tablets for recording upper limb movements and stereoscopic stimuli for 3D presentation using LCD glasses.



Cardiovascular Health Sciences Research Group Laboratories

The Cardiovascular Health Sciences Group acquire and analyse real-time images related to blood vessel and cardiac structure and function. Five stateof-the-art echocardiographic systems provide 2D, M-mode, Doppler, tissue-Doppler and strain imaging capacity (GE Ltd; Echopac), with additional software for coronary flow assessment and left ventricular opacification. A further five vascular ultrasound machines (Siemens; Terason) provide 2D and Doppler imaging of intima media thickness, diameter, flow, shear stress and endothelium (in) dependent dilation in blood vessels. Laser Doppler assessment of (skin) microvascular function can be combined with microdialysis of vasoactive substances, and trans-cranial Doppler assessment of cerebral perfusion. Electrocardiography (ECG) and finometry allow assessment of heart and vascular function. Data is acquired in three temperature-controlled ultrasound laboratories, complemented by an analysis room with dedicated, encrypted image and data server and workstations that include automated, validated and observer-independent vascular and cardiac analysis software.

Exercise Metabolism and Adaptation Research Group Laboratories

Bespoke integrated laboratories in the Tom Reilly Building provide ample space for treadmills and ergometers (cycle, rowing, arm and others) to investigate a wide range of acute exercise and training interventions in health and disease. Stateof-the-art equipment is used to measure functional outcome measures that include VO_{2max}, time-trial performance, muscle strength (various dynanometers), as well as body and muscle morphology (DEXA and ultrasound). State-of-the-art analytical facilities are used to measure blood and tissue metabolites and muscle proteomics (MALDI and ESA mass spectrometers).

The Life Sciences Building provides brand new, world-class research suites and analytical facilities. These enable the development of mechanistic research questions, relating to human adaptation from the cell to the human model. As a result, cellular and molecular physiology research is supported in the Life Sciences Building by: i) an imaging suite (confocal and wide-field fluorescence microscopy; inverted light microscopy; transmission electron microscopy) for visualisation of live cells and sections of muscle (heart and skeletal), tendon, bone, adipose tissue, vascular endothelium and smooth muscle cell layers; ii) a cell culture suite; iii) molecular biology and biochemistry laboratories for mRNA, DNA and protein analyses (RT-PCR, DNA methylation and polymorphism analyses, Western blotting, ELISA and FLOW cytometric analyses); iv) an HTA-approved LJMU human tissue bank; v) an HPLC suite; and vi) a DNA/ RNA suite with extensive PCR facilities.

Facilities for the Physical Activity Exchange and Football Exchange

The PAEx accesses exercise space and technical equipment in the Tom Reilly Building and CETL. Physical activity and/ or sedentary behaviour are assessed using uni- and tri-axial Actigraph accelerometers, GENEActivs devices (Actihearts), as well as portable heart rate, pedometer and indirect calorimetry systems. The preparation and analysis of physical activity data occurs in a dedicated laboratory that also includes 'exergaming' equipment, as well as video playback facilities to assess fundamental movement skills and systematic observational analysis. A paediatric exercise testing laboratory is used for the assessment of physiological function in children (peak VO₂). The FEx can access laboratory space in the Tom Reilly Building and CETL to link fundamental and applied work, as well as having a dedicated match analysis suite (16 workstations) in the CETL. The FEx also have extensive access to training and science facilities at a range of football clubs - including Liverpool and Manchester United, as well as at St. George's Park (FA) in order to collect specific training and match play data.

Get in touch

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