Paediatric cardiac exercise and sports cardiology research at the Bristol Congenital Heart Centre

**Research group: Exercise, cardiac function and sports cardiology**

*Principal investigators: Dr. Guido Pieles, Dr. Graham Stuart*

*External principal collaborator: Prof. Craig Williams*

Core collaborating institutions:

* Children’s Health and Exercise Research Centre, University of Exeter, (Prof. Craig Williams)
* Youth Football Academy at Manchester United FC
* Youth Academy at FC Barcelona
* ASPIRE Youth Sports Academy Doha/ Qatar

Non-educational sector partnerships:

Research collaboration between the University of Bristol and Toshiba Medicals UK and Europe (lead researcher Dr. G Pieles)

Background and scientific rationale:

Inactivity and related obesity are two of the biggest cardiovascular risk factors in children and young people in the UK. Strategies to tackle this substantial and ever increasing socio-economic burden (£1 billion annually) to the NHS are urgently needed. Innovative diagnostic imaging technologies are paramount in understanding the effects of exercise on the heart, diagnosing early heart dysfunction during exercise and predicting future health burden secondary to inactivity.

Over the last 3 years our research group has developed novel exercise imaging and prescription methodologies addressing this knowledge gap in a multi-level approach under the scientific lead of Dr. Guido Pieles and senior investigators Dr. Graham Stuart and Prof. Craig Williams. We have brought together leaders in the areas of: heart imaging technology (Toshiba Medicals UK and Europe), elite sport (Manchester United Football Club, FC Barcelona, ASPIRE Sports Academy Qatar), imaging research (CRIC Bristol), children’s health and exercise research (CHERC Exeter) and sports cardiology.

The overall aim of our research is to better understand cardiac physiology and pathophysiology under stress in healthy and chronically ill children as well as childhood athletes. This will inform the development of novel predictive models for earlier heart failure detection and treatment and improved monitoring of treatment progress in young patients with Congenital Heart Disease (CHD) and other chronic conditions.

A second core aspect is the in depth investigation of cardiac adaptation in childhood athletes. Data from the young athletes will be used to improve screening protocols for cardiac abnormalities and monitor performance in young athletes and serve as normative data for children with heart disease.

Our sports and exercise cardiology research programme aligns with the 2012 House of Lords Select Committee Report on Science and Technology, ‘Sport and Exercise Science and Medicine: Building on the Olympic legacy to improve the nation’s health’. It highlighted the need for strong biomedical science to enhance human performance and extend the research to general and clinical populations. Our strategic approach to synergise interdisciplinary research in athletes and patients is designed to result in significant advances in our understanding of how to maximize human health and provide evidence of the effectiveness of interventions to promote physical and mental health.

Progress and impact:

Our research group has an established interest in the interaction between sports cardiology, heart disease in the child and congenital heart disease in the adult. In 2014, we developed an innovative imaging strategy using MRI and echocardiography during exercise. This methodological approach has now been presented successfully at international conferences and published in leading physiology journals (see impact record below). Our paediatric exercise echocardiography studies have introduced the novel concept of simultaneous assessment of myocardial, pulmonary and metabolic exercise performance. Our method is presently being used under the leadership of Dr. Pieles in studies comparing myocardial exercise performance in elite childhood athletes (Manchester United FC, FC Barcelona and Aspire Athlete Academy Doha, Qatar) and non-athlete children (CHERC Exeter) and children with CHD (CRIC Bristol), and a collaborating study in children with pulmonary hypertension (SickKids Toronto, CA).

The research project has been ranked as one of the top three NIHR Bristol Cardiovascular BRU achievements 2015, has won poster prices at ESC level and our exemplary collaborative partnership with Toshiba and Manchester United has been commented on in an interview article with G Pieles by the highly ranked European Heart Journal (Pieles and Nicholls 2015) and attracted start-up grant funding (see below).

The research was also met with great interest in the general public and media since its first press release, with it being picked up by publishers ranging from BBC and IOC to Yahoo News, Times of Malta, and Al Jazeera Arabic. Since then it has also been featured several times by the BBC (Breakfast Show and more recently in the BAFTA winning CBBC children’s programme ‘Operation Ouch’) disseminating this vital research performed at the University of Bristol to a far broader audience than usual.

The project has also contributed to student education at the Universities of Bristol and Exeter (5 MSc students, 4 medical eSSC students) including a Wellcome Trust/ AMS INSIPRE grant and national INSIPRE research prize. Please see supplementary document for details on impact and publications.

Related Projects of our research group:

**Current research studies:**

* Defining cardiac adaptations to exercise using 2-D and 3-D echo strain imaging in patients with CHD and childhood elite athletes (funded by local charities Above & Beyond and David Telling Trust, PI G Pieles)
* Long term cardiac effects of elite training in childhood athletes (5 year project in collaboration with Manchester United Football Club, PI G Pieles)
* Cardiac effects of elite training in childhood athletes (Aspetar athlete academy Qatar, PI G Pieles)
* Cardiac exercise adaptations in patients with Barth Syndrome (NIHR EME study – PI Colin Steward, Co-I G Pieles)
* Correlation between cardiac function and SNP in ABC transporter genes in children with anthracycline induced cardiomyopathy (Funded by Children with Cancer UK, PI G Pieles)
* Profiling of RV acclimatisation to extreme altitude (hypobaric hypoxia >5000 m) by echocardiography and cardiac stress markers, part of APEX 4 expedition (Roslin Insitute / University of Edinburgh, Cardiac-PI G Pieles)
* Exercise prescription in children and Young adults with Congenital heart disease (Funded by Heart Research UK, PI Dr AG Stuart Collaborators: Lucy Gowing, Prof C Williams)
* Exercise gamification using Nike Fuel band (Funded Above and Beyond. PI Dr AG Stuart. Collaborators: Prof Ashley Cooper, Prof C Williams

**Upcoming international conferences where our research group will be engaged in:**

* First International Symposium in Paediatric Sports Cardiology, organised by our research group (Chair Dr G Pieles), Barcelona July 2017, as part of the World Congress in Paediatric Cardiology and Cardiac Surgery (WCPCCS)
* ESC Masterclass in Sports Cardiology, Barcelona August 2017 (Pieles)
* European College of Sports Science (ECSS) international conference Invited symposium on paediatric cardiac exercise adaptations, Bochum, 2017 (Pieles & Williams)
* ESC Europrevent – invited talks on “Exercise pathophysiology in CHD”, Malaga 2017 (Pieles, Williams & Stuart)
* ESC Europrevent – Satellite symposium “Heart health in youth athletes” – in collaboration with Toshiba and Manchester United Football Club and FC Barcelona, Istanbul 2016 (Pieles, Stuart)