Project Details	
Project Code	CMD27Ex Williams
Title	Sex-Specific Cardiac Remodelling in Female Athletes: Unravelling Cardiometabolic Risk and Long-Term Health Outcomes
Research Theme	Cardiometabolic Disease
Project Type	Wet lab
Summary	This project tackles a major challenge in biomedical research: the historical under-representation of women in cardiovascular and sports science. Much of what we know about the athlete's heart is based on male physiology, leaving important gaps in understanding how heart health differs in women. These gaps can contribute to inaccurate diagnosis and risk assessment. By generating sex-specific data and exploring how biological, social, and demographic factors interact, this research aims to improve equitable prevention and clinical care. Graduate students will have the opportunity to contribute to impactful, interdisciplinary science that advances both scientific discovery and health equity for diverse populations.
Description	Cardiovascular disease (CVD) is the leading cause of mortality in women worldwide, yet the female cardiovascular system remains profoundly understudied. Nowhere is this disparity more striking than in sports cardiology: a systematic audit of 767 studies examining exercise induced cardiac adaptation found that women constituted only 24% of 94,744 participants, with female only studies comprising just 5% of the evidence base (Smith et al., Am J Physiol Heart Circ Physiol, 2025). Strategies to address this imbalance have been explicitly called for (Mitchell et al., Br J Sports Med, 2024). Our mechanistic understanding of the "female athlete's heart" is therefore built almost entirely on male data, producing clinically significant knowledge deficits with direct consequences for athlete safety and long-term cardiometabolic health. Female athletes exhibit a distinct cardiac phenotype, including proportionally larger indexed chamber dimensions, sex specific ECG patterns, and a higher prevalence of eccentric remodelling (Lasocka Koriat et al., 2024). Differentiating these adaptations from pathological conditions including arrhythmogenic cardiomyopathy, hypertrophic cardiomyopathy and myocarditis remains clinically challenging and inadequately studied in women. For example, recent CMR data from 173 elite female athletes identified extreme remodelling phenotypes overlapping with disease (van Hattum et al., 2025), underscoring the need for more sex specific physiological and clinical data. Beyond structure, the long term cardiometabolic consequences of sustained high intensity training in women remain unknown. Sex hormones modulate vascular function, substrate metabolism, inflammation, and myocardial energetics; yet these mechanisms are absent from current athlete heart paradigms. Key Research Question 1. What are the sex-specific determinants of cardiac remodelling in female athletes, how does hormonal and metabolic mechanisms modulate this process, and what are the long-term cardiometabolic health implications of sustained high-intensity training in women? Specific Objectives

	1. Characterise cardiac structural and functional phenotypes in female athletes across sport disciplines through a systematic review focused on echocardiography, CMR, clinical biomarkers and cardiovascular fitness, thus generating sex specific data and predictors of cardiometabolic risk [Work Package 1 – systematic review – months 1-13]. 2. Apply targeted and untargeted profiling to identify biomarkers of exercise induced cardiac remodelling, cardiometabolic risk, and clinical health cardiorespiratory fitness (VO_2max) in female athletes versus age matched non athletic controls [Work Package 2 – data-base registry analyses – months 6-18]. 3. Investigate how hormonal cycle phase (via Hertility Health hormonal profiling), modulates cardiac adaptation and metabolomic signature; integrating continuous heart rate monitoring, actigraphy data collected via validated wearable devices, and cardiorespiratory fitness (VO_2max) during pre-season in professional female athletes. [Work Package 3 – laboratory and field based work – pilot studies – months 15-25]. a. Recruitment over early summer Pre-season testing (1 month, 4 lab visits): Baseline Early follicular testing Late follicular testing Mid-luteal testing Training load would be relatively constant at this point and would be easier to see how cycle phase impacts our outcomes. This would exclude participants who are on contraception as they don't have a regular cycle/ ovulation window, including only participants with regular ovulation.
Can be completed part time?	Yes
Supervisory Team	
Lead Supervisor	
Name	Professor Craig Williams
Affiliation	Exeter
College/Faculty	HLS
Department/School	PHSS
Email Address	c.a.williams@exeter.ac.uk
Co-Supervisor 1	
Name	Dr Jemma Perks
Affiliation	Exeter
College/Faculty	HLS
Department/School	PenArc
Co-Supervisor 2	
Name	Dr Eleni Nakou
Affiliation	Exeter
College/Faculty	HLS
Department/School	EMS
Co-Supervisor 3	
Name	

Affiliation	
College/Faculty	
Department/School	