

PROJECT PROPOSAL

2023 Academic Entry Year – Cohort 2

Supervisory Team

Primary Supervisor

Name: Dr Nicola Paine

Input (%): 70

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Centre/Institute/School/University:

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Secondary Supervisors

Name: Professor Nicolette (Lettie) Bishop

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Project Details

Project Summary

Title: Health inequalities in multimorbidity; the roles of stress, physical activity and sedentary behaviour on markers of disease risk

Summary:

Stress, physical (in)activity, and sedentary time are risk factors for non-communicable chronic diseases (NCDs). The presence of multimorbidities (e.g., obesity, hypertension, chronic systemic inflammation) are linked to these risk factors and contribute to NCD risk. Health inequalities accelerates multimorbidity development and may explain why NCDs (such as cardiovascular disease) occur at an earlier age in populations who experience health inequalities such as South Asians. This PhD will investigate interactions between stress, physical activity, and sedentary time on physiological risk markers of CVD in South Asian populations. These risk factors will also be assessed in the context of other multimorbidities that increase CVD risk (e.g., obesity, hypertension). No studies in South Asian populations have examined the impact of acute psychological stress on cardiovascular and inflammatory mechanisms; this project will be the first to do so, providing vital data on mechanisms which could explain increased CVD risk in South Asian populations. The project will yield skills and knowledge in experimental and behavioural medicine, under world-leading mentorship and training from the supervisory team. The project will be based in the renowned National Centre for Sport and Exercise Medicine (Loughborough University). The successful candidate will receive training in all assessments and techniques required for the PhD

Theme(s) the project most closely aligns to:

Cardiovascular, Obesity and Renal

How the PhD project and training would be appropriate for NMAHPs or GPs:

This PhD will provide skills and knowledge in experimental and behavioural medicine, assessing stress, physical activity and sedentary behaviour, in the context of clinically relevant risk markers. The student will use world-leading facilities in Paine's laboratory in the National Centre for Sport and Exercise Medicine (Loughborough University). Interdisciplinary training, across cardiovascular and psychobiology disciplines, comes via exceptional training from the supervisory team. Paine (psychobiology, cardiovascular, movement behaviours) has received prestigious fellowships (inc. AMS Springboard) in these research areas; Bishop is a world-leading expert in exercise immunology and inflammation. They have supervised ~20 PhDs to completion. Postgraduate training is provided by Loughborough University's Doctoral College (>200 events/year to meet Vitae's Researcher Development Framework), activities hosted by SSEHS research themes and the Leicester NIHR BRC.

How the project addresses health inequalities:

Leicestershire Healthcare Inequalities Improvement DTP

CVD risk is not equal. South Asian (SA) populations - individuals of Asian, Asian British, Indian, Pakistani or Bangladeshi backgrounds¹ - have substantially higher CVD risk, with elevated risk factors including inflammation², blood pressure³, and adiposity¹, than White Europeans. SAs represent ~25% of the global population¹, ~7.5% of the UK population, and present a growing, high-risk but under-researched group for developing CVD⁴ and especially in the context of psychological stress, which disproportionately impacts minority groups, and is a trigger for CVD events⁵. SAs are younger when cardiovascular (CV) events occur⁶ which typically manifests up to 10 years earlier and at lower body mass index (BMI) compared to White Europeans¹. The reasons for this are poorly understood. UK adults spend ~10h/day sedentary⁷, which is concerning as mortality is greater when sedentary for >9.5h/day⁸, and SA populations are typically more sedentary than White Europeans⁹, plausibly explaining why SAs have elevated CVD risk¹⁰. Physical inactivity exacerbates other CVD risk factors in SAs including obesity and dyslipidaemia in the background of genetic predisposition⁴. Understanding the mechanisms behind this increased risk will help to develop bespoke interventions and treatments to reduce CVD risk (and other multimorbidity conditions) and tackle health inequalities.

References: ¹Sattar et al., 2015, *Lancet Diabetes Endocrinol*, 3, 1004-16; ²Volgman et al., 2018, *Circulation*, 138 e1-e34; ³Rana et al., 2014, *CMAJ open*, 2, E183-E91; ⁴Misra et al., 2013, *Nutrients*, 5, 2708-33; ⁵Pimple et al., 2019, *J Am Heart Assoc*, 8, e011866; ⁶Vyas et al., 2021, *Heart*, 107, 996-1002; ⁷Chantry et al., 2022, *Psychoneuroendocrinology*, 141, 105756; ⁸Ekelund et al., 2019, *BMJ*, 366, l4570; ⁹Yates et al., 2015, *BMJ open*, 5, e006181-e; ¹⁰Tillin et al., 2013, *Diabetes Care*, 36, 383-93

Aim:

To assess, the effects of stress, sedentary behaviour and physical activity on multimorbidities in SA populations, on the following measures under conditions of rest and acute psychological stress: i) cardiovascular (e.g., BP, HR); ii) inflammatory (e.g., IL-6); iii) neuroendocrine (e.g., cortisol)

Background:

Cardiovascular disease (CVD) is a leading cause of global disease burden¹ and often occurs in the presence of multimorbidities which are both physical (e.g., obesity, hypertension, chronic systemic inflammation) and psychological (e.g., stress, depression). CVD risk is higher at an earlier age in South Asian populations. Acute psychological stress can trigger acute cardiac events², and physiological responses to stress can predict CVD risk. Stress disproportionately affects groups who experience health inequalities and may explain increased CVD risk. The presence of multimorbidities cumulatively increase mortality³, but mechanisms and potential interactions behind this are unclear. Health inequalities accelerates multimorbidity development; with greater health inequalities multimorbidity occurs earlier⁴. 70% of CVD risk is explained by modifiable risk factors⁵, including sedentary lifestyle (SED) and low physical activity (PA), providing avenues for interventions to yield wide-ranging CVD benefits⁶. Inflammation is a characteristic which is common across SED, physical (in)activity, and increases under stress. We have shown sedentary lifestyles in White Europeans yield a larger inflammatory and cardiovascular responses to acute stress⁷. If this is the same for South Asian populations and the longer-term implications of this are remain unknown.

Leicestershire Healthcare Inequalities Improvement DTP

References: ¹Vos et al., 2020, *The Lancet*, 396, 1204-22; ² Kivimäki et al., 2018, *Nat Rev Cardiol*, 15, 215-29; ³ Gallacher et al., 2018, *J Comorb*, 8; 1-8; ⁴ Schiøtz et al., 2017, *BMC Public Health*, 17, 422; ⁵ Yusuf et al., 2020, *Lancet*, 395, 795-808; ⁶ Bull et al., 2020, *Br J Sports Med*, 54, 1451; ⁷ Chantry et al., 2022, *Psychoneuroendocrinology*, 141, 105756