Project Details	
Project Code	MRCNMH25Br Wootton
Title	The MEME project: Making Exercise interventions More Effective for depression and anxiety.
Research Theme	Neuroscience & Mental Health
Summary	Exercise has been repeatedly shown to improve symptoms of depression and anxiety. Therefore, prescribing exercise could be an effective alternative (or adjunct) to treatment for the growing number of individuals presenting to mental health services. However, little is known about which mechanisms make exercise interventions effective and therefore, clinicians have limited evidence on which to tailor prescriptions of exercise. The MEME Project aims to address this knowledge gap, implementing novel wearable technologies into existing exercise interventions and using causal inference techniques from the fields of (genetic) epidemiology to explore the efficacy of exercise interventions from an innovative angle.
Description	Across multiple meta-analyses and reviews, exercise is repeatedly shown to improve symptoms of depression and anxiety in both clinical and non-clinical populations1. Most recently, an umbrella review, found that all modes of exercise were effective in the reduction of depression, anxiety, and psychological distress1. Therefore, prescribing exercise is recognised to be an effective alternative (or adjunct) treatment for individuals with current depression and anxiety. Exercise may work through multiple biological and psychosocial pathways2. However, there remains a surprising lack of well powered studies using objective measures that explore the mechanisms underlying the efficacy of exercise interventions. Consequently, clinicians can be reluctant to prescribe exercise to patients because of the lack of an evidence-based framework3 making it difficult to know for whom exercise will be effective, and how the exercise should be tailored to the individual. The overall aim of the MEME project is to use innovative methodologies to better understand why exercise interventions are effective for individuals with depression and anxiety, and why they are more effective for some individuals than others. This overarching aim will be achieved through three different methodological approaches: 1) Using wearable technology to understand how exercise, proposed mechanisms and mental health symptoms interact in real time The PhD student will embed wearable technology into an existing exercise intervention for students with depression and anxiety at the University of Bristol called Healthy Minds. The Healthy Minds exercise intervention is currently offered to students experiencing wellbeing concerns, including elevated depression and anxiety. This programme is 12-weeks in duration, utilising a bespoke programme of physical activity to teach skills and tools needed to support and develop positive behaviour change for its participants. The PhD student will evaluate the existing programme using data from previous participants, along with collecting new data from wearable technology during this project. This will follow on from previous user involvement and pilot work carried out by the supervisory team, which has shown feasibility of using wearable technology to this end in a general population sample. Specifically, the wearable devices will be smart rings, which passively collect data on

physical activity, sleep, temperature and heart rate. Participants will also answer ecological momentary assessment (EMA) question prompts delivered to their smartphones multiple times per day. EMA questions will cover depression and anxiety symptoms, and measures of the selected mechanisms, for example, their psychological motivations for exercise or questions about the type of exercise.

2) Longitudinal mediation analysis using population cohort data

For the second objective, the PhD student will use epidemiological methods in the large-scale, prospective population birth cohort of the Avon Longitudinal Study of Parents and Children (ALSPAC)4 to explore how several proposed mechanisms impact depression and anxiety symptoms longitudinally. The student will test how the association between exercise frequency and depression/anxiety symptoms is mediated by their mechanisms of interest. We have access to a wealth of longitudinal cohort data including extensive measures of self-reported symptoms of depression and anxiety, exercise frequency, and possible mechanisms.

3) Genetic causal inference with Multivariable Mendelian randomization

For the third objective, the student will triangulate these longitudinal observational methods with state-of-the-art causal inference techniques from the field of genetic epidemiology in the form of Multivariable Mendelian randomisation (MVMR)5. MVMR uses genetic variants as instrumental variables to minimise bias from confounding and reverse causation. Genetic instruments are available for several possible mechanisms (e.g. sleep duration, cardiovascular fitness, resistance training).

Each methodological approach will comprise at least one publication for the PhD student. Triangulating across several different methodologies not only provides stronger evidence to better inform intervention development, but also creates an excellent training opportunity for the student to develop a broad range of skills for their future career.

Given the scope of the PhD project, we propose that the PhD student will focus on three or four specific possible mechanisms that could make important intervention targets in future work. We give flexibility and self-direction to the student in selecting specific mechanisms. However, as some examples, the PhD student might wish to focus on 1) motivations for exercise, including enjoyment of exercise, feelings of guilt, and exercise goals (e.g. weight loss), 2) sleep, which could be an important mediator of the relationship between exercise and improved depression/anxiety and can be measured passively using our wearable devices, and 3) the type of exercise, for example, either cardiovascular or resistance training, or whether the exercise is conducted alone or with others.

Understanding how each of these factors contributes to the mechanisms of exercise will help to inform frameworks for prescribing exercise as an (adjunct to) treatment, reducing the mental health burden.

References

1. Singh et al. 2023. DOI:10.1136/bjsports-2022-106195
2. Kandola et al. 2019. DOI:10.1016/j.neubiorev.2019.09.040
3. Garvey et al. 2023. DOI:10.1111/inm.13089
4. Fraser et al. 2013. DOI:10.1093/ije/dys066

	5. Sanderson et al. 2021. DOI:10.1101/cshperspect.a038984
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