**LEICESTER LIFESTYLE AND HEALTH RESEARCH GROUP**

**Physical activity, circadian rhythms and health outcomes: Optimising the response using a personalised approach**

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**Section 2 – *Project Information***

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| **Project Title** | **Physical activity, circadian rhythms and health outcomes: Optimising the response using a personalised approach** |
| **Project Summary** | |
| *Aim:* To evaluate the timing and intensity of physical activity in accordance with the circadian rhythm on health outcomes in individuals living with and without type 2 diabetes (T2DM).  *Background:* Although physical activity is a cornerstone treatment for the management of chronic disease (including T2DM) (1), its application is often based on a one-size-fits-all approach. Moreover, there is considerable variability in how individuals respond. It is hypothesised that the intra-individual variability is partly driven by chronotype, which is closely related to the circadian system, controlling 24-hour cycles of behaviour and physiology (4). Indeed, those living with T2DM demonstrate signs indicative of clock disruption, which can lead to impaired glucose control (5). Although light is the most important time cue to realign the circadian system, physical activity may also act as a potent environmental cue to foster chrono-biological homeostasis which is constantly being challenged by modern 24/7 society (6). Despite holding great translational potential, the impact of such an approach in those living with chronic disease(s) is unknown.  *Methods:* This programme of work will encompass epidemiological and experimental methodologies.  Work Package 1-Epidemiology (years 1-3)  In collaboration with the Leicester Real World Evidence Unit, this work package will use local and national datasets (e.g., UK BIOBANK), which include time-stamped physical activity to explore how differences in the timing and intensity, relative to chronotype preference, influence health outcomes.  Work Package 2-Experimental (Year 2-3)  An N-of-1 randomised controlled trial study design (i.e., a pooled crossover experiment with each participant acting as their own control over a series of interventions) will be used to investigate whether the timing and/or intensity of physical activity interacts with chronotype in promoting glucose control (via continuous glucose monitoring) in those living with T2DM. Briefly, individuals will undertake the following interventions in a random order: a) Control, b) Morning physical activity: 1-2 hours before breakfast, c) Afternoon physical activity: 1-2 hours before afternoon meal, d) Evening physical activity: 1-2 hours before evening meal.  *Expected outcomes and impact:* A minimum of 2 high quality research outcomes will be produced. These will be complimented by focused knowledge exchange activities (e.g., conference attendance). This multi-disciplinary, cross-cutting application will explore how physical activity and sleep interventions can be combined to optimise health outcomes, which will allow greater patient choice, alongside more personalised, evidence-based care. | |
| **References** | |
| 1) Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, Rosas SE, Del Prato S, Mathieu C, Mingrone G, Rossing P, Tankova T, Tsapas A, Buse JB. Management of Hyperglycemia in Type 2 Diabetes, 2022. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2022 Nov 1;45(11):2753-2786. doi: 10.2337/dci22-0034. PMID: 36148880; PMCID: PMC10008140.  2) Huang W, Ramsey KM, Marcheva B, Bass J. Circadian rhythms, sleep, and metabolism. J Clin Invest. 2011 Jun;121(6):2133-41. doi: 10.1172/JCI46043. Epub 2011 Jun 1. PMID: 21633182; PMCID: PMC3104765.  3) Van Cauter E, Polonsky KS, Scheen AJ. Roles of circadian rhythmicity and sleep in human glucose regulation. Endocr Rev. 1997 Oct;18(5):716-38. doi: 10.1210/edrv.18.5.0317. PMID: 9331550.  4) Shen B, Ma C, Wu G, Liu H, Chen L, Yang G. Effects of exercise on circadian rhythms in humans. Front Pharmacol. 2023 Oct 11;14:1282357. doi: 10.3389/fphar.2023.1282357. PMID: 37886134; PMCID: PMC10598774. | |