What diet and time-use compositions have equivalent risk of cardiovascular health outcomes?

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It is well documented that diet, in addition to time-use (composition of physical activity, sedentary behaviour and sleep in the 24-hour day), is a predictor of cardiovascular health. It is plausible that if someone is unable to improve their time-use, they could achieve equivalent reduction in their cardiovascular disease (CVD) risk by improving their diet instead, or alternatively, improve both time-use and diet simultaneously, requiring smaller modifications of each to achieve an equivalent reduction in CVD risk. By investigating both time-use and diet behaviours in this integrated way, creation of personalised diet and time-use recommendations that account for individual preferences, circumstances and lifestyles can be facilitated. Currently, the diversity of time-use and diet compositions that are associated with equivalent CVD risk in adults is unknown. The aim of this proposed study is to investigate how time-use and diet compositions are associated with equivalent CVD risk.

For time-use, the proposed study will use derived accelerometer data in the UK Biobank (Field ID 40030-40049), representing the average daily proportion of sleep, sedentary behaviour, light and moderate-vigorous physical activity across a 7-day window. Diet will include macronutrient profile data (Biobank Data items 100003-100005), specifically amount of carbohydrates (data field 100003), proteins (data field 100004), and fats (data field 100005) consumed yesterday, represented as a percentage of total energy obtained from these three macronutrients. Total energy intake, including intake from foods not part of the composition, will be used a separate covariate to adjust for caloric intake in tandem with the nutritional composition. CVD risk will be represented by Framingham Risk Score (FRS), a score used to estimate 10-year risk of heart attack in adults age 30-79, and is commonly used to quantify CVD risk. The variables used to calculate FRS are age, sex, current smoking status, total cholesterol, HDL cholesterol, systolic BP and current treatment for BP. For this proposed study custom R-code will be used to calculate a score based on the equivalent variables available from the UK Biobank.

Compositional multiple linear regression models will be used to explore the associations of time-use and macronutrient compositions with CVD risk. Time-use *ilrs* and macronutrient *ilrs* will be used as the independent variables of interest, and FRS will be the dependent variable. Covariates will include total energy intake and sociodemographic factors. Interactions and non-linear (quadratic terms) will be tested and retained if they improve the model (ANOVA of model comparison $p<0.05$). The *ilr* coefficients will be interpreted as the estimated difference in risk score when one time-use behaviour, or one macronutrient, is increased/decreased relative to the remaining components. Equivalence modelling equations will be used to determine a selection of time-use and macronutrient behaviour changes associated with equivalent predicted reduction in FRS.

We hypothesise that compositions with higher physical activity, less sedentary behaviour, and less fat consumption have reduced risk of developing CVD, via FRS. Preliminary data will be available to present at the symposium.