Study Title: Effect of Low Volume Sprint Interval Training on Cardiorespiratory Fitness

NCT number: To be determined

Date: 12/15/2025

Statistical design and power

The proposed study *Effect of Low Volume Sprint Interval Training on Cardiorespiratory Fitness; A Randomized Controlled Trial* is a longitudinal, randomized controlled trial comparing the efficacy of REHIT at improving cardiometabolic health in comparison to a no-intervention control group. At baseline, participants will be randomized into the exercise condition or a control group by a statistician, with an allocation ratio of 1:1. Research staff will not have access to the randomization list.

Data will be expressed as mean ± standard deviation and will be analyzed using SPSS V. 27.0 (IBM, Armonk, NY). The Shapiro-Wilks test will be used to assess normality of each variable. Changes in outcomes will be analyzed using two-way mixed-model ANOVA, with time as a within-subjects factor (pre- vs. 4 wks vs. 8 wks) and group (REHIT vs. control) as a between-subjects factor. Changes in exercise enjoyment will be analyzed using a repeated measures ANOVA. If a significant F-ratio occurs, Tukey's *post hoc* test will be used to identify differences between means. The Greenhouse-Geisser correction will be used if the sphericity assumption of equal variances across groups is not met. Unpaired t-test will be used to identify baseline differences in age, BMI, and/or $\dot{V}O_2$max between groups. If there is a baseline difference in any outcome between groups, it will be used as a covariate in our analysis. Cohen's *d* will be used as a measure of effect size and represented using these values: 0.20-0.49 = "small," 0.50-0.79 = "moderate," and $\geq$0.80 = "large". Both intention-to-treat analysis (including all randomized participants with data for baseline and follow-up timepoints) and per protocol analysis (including all participants with >75% of prescribed sessions completed) will be performed.

Sample size calculation:

In a pooled analysis of n=117 sedentary participants performing 6 weeks of REHIT, we established a mean increase in $\dot{V}O_2$max of 9.3% with a standard deviation of individual responses (SD_{IR}) of 2.4 $mL \cdot kg^{-1} \cdot min^{-1}$ (Metcalfe and Vollaard, 2021). This was similar to the 10.0% increase in $\dot{V}O_2$max with an SD_{IR} of 2.5 $mL \cdot kg^{-1} \cdot min^{-1}$ which we observed in a cohort of sedentary individuals performing 6 weeks of supervised SIT (n=136, METAPREDICT Study; (Phillips et al., 2017)), and to the SD_{IR} of the training response reported by the HERITAGE Family Study following 20 weeks of MICT (n=720; SD=2.7 $mL \cdot kg^{-1} \cdot min^{-1}$ (Bouchard and Rankinen, 2001)). This suggests that these are "typical" values for between-subject variability in the response for $\dot{V}O_2$max following training. Therefore, these can be considered suitable data for use in the sample size calculation for the proposed project.

An increase in $\dot{V}O_2$max equivalent to 1 MET (3.5 $mL \cdot kg^{-1} \cdot min^{-1}$) is expected to reduce risk of all-cause and CVD mortality by 15% and 19%, respectively (Lee et al., 2011). In the absence of a universally accepted smallest clinically meaningful effect for the primary outcome measure of $\dot{V}O_2$max used in the present study, we define the smallest worthwhile difference in the change in $\dot{V}O_2$max between the intervention and control groups as 1.5 $mL \cdot kg^{-1} \cdot min^{-1}$ (~4.5% increase in $\dot{V}O_2$max), equivalent to a risk reduction for CVD mortality of ~8%. Thus, in order to be able to detect the smallest worthwhile difference with an effect size of *d*=0.60, we need n=120 participants in total (with n=60 participants randomized to the training group and n=60 to the control group) with alpha=0.05 and power of 90%. A secondary analysis of sex differences in the response to REHIT will be performed, sufficiently powered to detect a large effect size (*d*=0.80) with alpha=0.05 and a power of 80%. We will recruit participants until the target has been achieved.

Despite dozens of studies exhibiting beneficial effects of exercise training on lipid oxidation, no study has identified a smallest worthwhile change for this outcome. However, with a sample size of n=120 established for the primary outcome measure of training-induced change in $\dot{V}O_2$max, our study will be sufficiently powered to detect changes in lipid oxidation (Aim 2) with a medium effect size of *d*=0.52, with alpha=0.05 and power of 80%.

Exercise enjoyment as measured using the PACES questionnaire is only assessed in the intervention group, with changes analysed using a repeated measures ANOVA. The study will be sufficiently powered to detect changes in exercise enjoyment (Aim 3) with a small effect size of f=0.14, with alpha=0.05 and power of 90%.