STATISTICAL ANALYSIS PLAN

Overview

This SAP prespecifies methods for comparing a four-week national camp with club training over 28 days. The primary objective is to test whether camp participation yields a greater increase in resting RMSSD from Day 1 to Day 28. Secondary objectives cover SDNN, LF/HF, morning salivary cortisol, PSS-10, PANAS-C, PSQI, EISA-24 and weekly CR-10.

Analysis populations

Full Analysis Set includes all enrolled participants with the relevant outcome at Day 1 and Day 28. Per-Protocol Set includes the Full Analysis Set with no major deviations and at least two of three HRV sessions completed on schedule (or both sessions for PSQI and EISA-24). A safety/feasibility set includes all enrolled.

Outcomes and timepoints

Primary outcome is RMSSD (ms) from five-minute seated morning HRV recordings (Polar H10, Polar Electro Oy, Finland; Kubios HRV v3.x, Kubios Oy, Finland) at Day 1, Day 14, Day 28; primary endpoint is change Day 1→Day 28. Secondary outcomes are SDNN and LF/HF from the same HRV sessions; morning salivary cortisol (nmol/L) by ELISA (Salimetrics LLC, USA; read on BioTek Epoch 2, Agilent BioTek, USA) at Day 1, Day 14, Day 28; PSS-10 and PANAS-C at Day 1, Day 14, Day 28; PSQI and EISA-24 at Day 1 and Day 28; weekly CR-10 means over Weeks 1–4.

General principles

Two-sided $\alpha=0.05$ for the primary endpoint. Secondary endpoints are exploratory; 95% confidence intervals will be reported and, where multiple related tests occur within a domain, false discovery rate control (Benjamini–Hochberg) will be applied. Continuous outcomes will be summarised by mean (SD) and median (IQR); categorical by counts and percentages. Models adjust for baseline outcome and prespecified covariates.

Covariates

Age, sex, years in orienteering, baseline training volume, and the baseline value of the outcome. Where feasible, coach or site will be included as a random or fixed effect in sensitivity analyses.

Primary analysis

Between-group comparison of ΔRMSSD (Day 1→Day 28) using multivariable linear regression with robust standard errors. The adjusted mean difference (camp – club) is reported with 95% CI and p-value.

Repeated-measures analyses

Supportive linear mixed-effects models with random intercepts (participant) and fixed effects for time (Day 1, Day 14, Day 28), group, and group×time will be fitted for RMSSD, SDNN, LF/HF, cortisol, PSS-10 and PANAS-C. The covariance structure will be chosen by AIC. Time-specific contrasts will estimate Day 14 and Day 28 differences.

Secondary endpoints

SDNN and LF/HF use models analogous to the primary analysis. Cortisol will be log-transformed if skewed; change models and mixed-effects trajectories will be reported with geometric mean ratios. PSS-10 and PANAS-C changes will be analysed with adjusted linear models; proportional-odds models may be used if distributions are highly skewed. PSQI and EISA-24 change will be analysed with adjusted linear regression. Weekly CR-10 means will be compared using adjusted linear models and an exploratory mixed model with week as a repeated factor.

Missing data

If outcome missingness is ≤5%, complete-case analysis will be primary. If >5%, multiple imputation by chained equations will be used, including group, baseline covariates and auxiliary variables such as training

volume; at least 20 imputations will be combined with Rubin's rules. Sensitivity analyses will include best/worst-case bounds, pattern-mixture models and δ-adjustment scenarios.

Data quality and outliers
HRV artefacts will be corrected in Kubios (automatic beat correction, medium threshold); sessions with >5% corrected beats will be flagged and tested in sensitivity analyses. Cortisol outliers (±3 SD) will be reviewed against sampling and assay notes; protocol deviations will be excluded from the Per-Protocol Set.

Subgroups and exploratory analyses
Prespecified subgroups are sex and baseline RMSSD (median split). Group×subgroup interactions will be assessed cautiously and interpreted as exploratory. Associations between weekly CR-10 and changes in HRV/cortisol will be explored with mixed models within groups.

Multiplicity, interim analyses and software
The primary endpoint will be tested once at $\alpha=0.05$. No interim hypothesis testing is planned. Analyses will be done in R or Python with version-controlled scripts; code and de-identified summary tables will be shared at publication.

Tables and figures (planned)
Baseline characteristics by group; adjusted changes Day 1→Day 28; HRV and cortisol trajectories.

Deviations from this SAP
Any deviations will be documented, justified before unblinded group-level summaries, and appended to the manuscript and registry.