STUDY PROTOCOL WITH STATISTICAL ANALYSIS PLAN

Official Title:
Investigation of Cognitive Responses to Acute Diving Training in Female Diving Athletes

Short Title:
Cognitive Responses to Acute Diving Training

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Study Protocol with Statistical Analysis Plan

Sponsor:
Trakya University

Study Design
This study is designed as a single-center, prospective, randomized crossover trial investigating the acute cognitive, physiological, and mood responses to breath-hold diving exercises performed in land and water environments.

Study Objective
The primary aim of this study is to investigate the acute effects of breath-hold diving exercises on cognitive performance, mood state, respiratory function, and cardiovascular responses in licensed female free-diving athletes.

Study Population
Licensed female free-diving athletes aged between 18–30 years with at least five years of regular training experience will be included in the study.

Study Procedures
Participants will attend three separate sessions:

1. Control session
2. Land-based breath-hold session
3. Water-based breath-hold session

During each session:

- Resting heart rate will be recorded
- Anthropometric measurements will be performed
- Brunel Mood Scale (BRUMS) questionnaires will be completed

- Cognitive performance will be evaluated using the 2-Back (N-Back) test
- Respiratory function tests will be conducted
- Maximum breath-hold duration tests will be performed

The order of land and water sessions will be randomized using a crossover design.

Primary Outcome Measures

- Cognitive performance (2-Back test accuracy and reaction time)
- Mood state changes (BRUMS scores)

Secondary Outcome Measures

- Maximum breath-hold duration
- Resting and exercise heart rate responses
- Respiratory function parameters

Safety Considerations
All water-based sessions will be supervised by certified free-diving and lifeguard personnel. Testing procedures will immediately be terminated if adverse physiological symptoms occur.

Ethical Approval
The study protocol has been submitted to the Trakya University Faculty of Medicine Non-Interventional Scientific Research Ethics Committee.

Informed Consent
Written informed consent will be obtained from all participants before enrollment.

STATISTICAL ANALYSIS PLAN

Statistical Software
All statistical analyses will be performed using IBM SPSS Statistics 27.0 and JASP Statistics Software (Version 0.19).

Data Presentation
Continuous variables will be presented as mean ± standard deviation (SD). Categorical variables will be expressed as frequencies and percentages.

Assumption Testing
The normality of data distribution will be assessed using the Shapiro–Wilk test.

Homogeneity of variances will be evaluated using Levene's test.

Sphericity assumptions will be tested using Mauchly's test. Greenhouse–Geisser corrections will be applied when necessary.

Primary Statistical Analysis
Differences between control, land, and water sessions for cognitive performance, mood state, heart rate responses, and respiratory parameters will be analyzed using two-way repeated-measures ANOVA (condition × time).

Post-Hoc Analysis
Bonferroni-adjusted pairwise comparisons will be conducted when statistically significant main or interaction effects are identified.

Non-Parametric Analysis
If data do not satisfy normality assumptions, Friedman tests will be used for repeated measures comparisons.

Wilcoxon signed-rank tests will be performed for post-hoc pairwise comparisons.

Correlation Analysis
Pearson correlation analysis will be used for normally distributed variables.

Spearman correlation analysis will be used for non-normally distributed variables.

Effect Size Analysis
Partial eta squared ($\eta^2 p$) values will be calculated for ANOVA analyses.

Cohen's d effect sizes will be calculated for pairwise comparisons.

Missing Data Management
Participants with incomplete primary outcome data will be excluded from the related analyses. No imputation method will be applied.

Statistical Significance
Statistical significance will be accepted as $p < 0.05$.