

## **Abstract**

### **Title:**

Utilization of lactate during exercise in the context of genetic dispositions

### **Objectives:**

The aim of the dissertation is to investigate, within a group of athletes from speed-endurance disciplines, the influence of selected polymorphisms in genes encoding lactate transporters MCT1-4 on lactate levels before, during, and after Intermittent 30s Wingate Test. A sub-objective of the study is to identify differences in allele and genotype frequencies in the respective polymorphisms between the group of athletes and controls.

### **Methods:**

The research group consisted of 91 Eastern European Caucasian men, members of the Czech Athletic Association with elite performance in the 400 m run (age  $20.4 \pm 3.2$  years; body weight  $74.07 \pm 7.5$  kg; height  $182.7 \pm 6.14$  cm). A control group ( $n=100$ ; age  $20.5 \pm 1.2$ ; body mass  $77.5 \pm 9.47$  kg; height  $181.5 \pm 6.35$  cm) of physically active individuals who did not perform speed and strength sports was used for allele and genotype comparisons. For genotypic analysis of selected polymorphisms, buccal mucosa swabs were performed in the probands. DNA isolation and subsequent genetic analyses were performed in collaboration with the Józef Piłsudski University of Physical Education in Warsaw. The frequencies of individual alleles and genotypes were tested for compliance with Hardy-Weiberg equilibrium using  $\chi^2$ . Basic anthropometry and body composition were measured with an A213 portable wall-mounted anthropometer and a Tanita BC 418 body composition analyzer. Prerequisites for speed abilities were evaluated based on the results obtained in the Squat jump and Countermovement jump. Intermittent 30s Wingate test (WT30) on a bicycle ergometer (Monark 894E Peak bike, MONARK, Sweden) with a rest interval of 4 min between tests was used to diagnose anaerobic preconditions and to increase lactate levels. To determine the lactate level collected from the fingertips 20  $\mu$ l of capillary blood immediately upon arrival in the laboratory, after a 2-min warm-up on a bicycle ergometer, in the 3rd min after the completion of the 1st Wingate Test (WT1), immediately after the completion of the 2nd Wingate Test (WT2), and subsequently in the 3rd, 6th, 9th, 20th and 30th min after WT2. Lactate level analysis was performed with the

Biosen C-line Clinic (EKF Diagnostic, Barleben, Germany). The normality assumption of the distribution of continuous variables was tested using Kolmogorov-Smirnov. Differences during repeated measurements of lactate between individual genotypes in a group of athletes were analyzed for different inheritance models using a two-way mixed ANOVA with one between-group factor (belonging to a given genotype) and one repeated (within-group) factor (10 measurements of lactate over time). Data analysis and summarization of results were performed in SPSS version 25 and the ggplot2 package in the R program. Statistical significance was accepted at the threshold of  $p < 0.05$ . For evaluating the effect size within the ANOVA models,  $\eta^2$  was adopted, which represents at least a medium effect size of  $0,04 < \eta^2 \leq 0,09$ .

## Results

All monitored polymorphisms fulfilled the Hardy-Weinberg equilibrium ( $p > 0.05$ ). Statistically significant differences in allele frequencies between athletes and controls were observed in the polymorphisms MCT2 rs3763980 ( $p=0.03$ ) and MCT2 rs995343 ( $p=0.04$ ). We identified an association between specific genotypes and metabolic responses to increased stress in the polymorphisms MCT1 rs3789592, rs7556664, rs6537765, 7169, 1049434, MCT2 rs995343, rs3763979. These variants may influence the ability to utilize lactate as an energy source, consequently impacting an athlete's ability to sustain high-performance levels during a race.

## Keywords:

anaerobic performance, lactate, monocarboxylic transporters, polymorphism