Journal of Science & Cycling
Breakthroughs in Cycling & Triathlon Sciences

OPEN ACCESS

*Conference Abstract*

# Creatine Supplementation and Maximal Rate of Lactate Accumulation Following a 15-s All-Out Sprint Test

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**Received:** 29 February 2024 **Accepted:** 30 March 2024 **Published:** 10 August 2024

**Abstract:** $vLa_{max}$ is traditionally tested in a 15-s all-out sprint test. The variable is based on Mader's model of energy system contributions and acts as a surrogate for the maximal glycolytic rate. On this foundation, $vLa_{max}$ is not only used as a predictor for sprint performance but for endurance efforts as well. The aim of this study was to determine the effect of creatine supplementation on the results of testing procedure. 12 amateur cyclists (more forthcoming) were recruited. Participants performed a 15-s all-out sprint test on a Cyclus2-ergometer. Capillary blood lactate was sampled in the 8 minutes following the test. Participants underwent the testing procedure four times under different conditions in this order: a familiarization trial, baseline, placebo (4x5 g/d maltodextrin for 5 d) and creatine supplementation (4x5 g/d creatine monohydrate for 5 d). Weight and body composition was determined using BIA on each visit. At present state, ANOVA revealed significant a significant increase in fat-free mass under the creatine condition compared to all other conditions. For all other measures (peak and mean power output, ΔLa, calculated total body lactate production), no differences were found between different conditions. Based on the data at hand, a loading phase of creatine supplementation increases fat-free mass. Tendencies of mean values across groups show an increase in mean power output over the 15-s all-out sprint test under the creatine condition while simultaneously decreasing ΔLa compared to baseline and placebo condition. However, no statistical significance was reached. Further research is needed to determine the influence of a popular ergogenic aid on metabolic testing of glycolytic rate.

**Keywords:** Diagnostic, Anaerobic, $vLa_{max}$, Sprint, Ergogenic Supplements

## 1. Introduction

In recent years, the testing procedure of maximal rate of lactate accumulation following a 15-s all-out cycling sprint has become a popular diagnostic tool. This method is based on Mader's mathematical model of metabolism (Hauser et al., 2014; Mader, 2003; Mader & Heck, 1986).

In theory, the procedure attempts to estimate the maximal rate of anaerobic glycolysis, of which lactate is the end product (Brooks, 2007; Heck & Schulz, 2002). The validity of this testing procedure as a suggested surrogate marker for phosphofructokinase activity of the working musculature remains doubtful. However, glycolytic performance has been shown to be directly connected to blood lactate levels in the recovery period (di Prampero & Ferretti, 1999).

The resulting metabolic parameter of $vLa_{max}$ is widely used by practitioners and coaches in endurance sports as a result of its suggested influence on endurance

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parameters as described in Mader's model. The existing body of literature reports good to excellent reliability for this procedure ( (Adam et al., 2015; B. Meixner et al., 2024; Quittmann et al., 2020). Additionally, some studies suggest the usefulness of the parameter in endurance performance (Hauser et al., 2014; Ji et al., 2021; Quittmann et al., 2021).

Originally, the method to determine glycolytic contribution via a metabolic equivalent of lactate accumulation has been suggested by Margaria et. Al (Margaria et al., 1963). Recently, we were able to show a linear relation between lactate accumulation and $P_{mean}$ in a 15-s all-out sprint when FFM was taken into consideration (B. J. Meixner et al., 2024).

Creatine is a popular ergogenic aid for anaerobic performance (Maughan, 1995). It has been shown to increase body water (i.e. lactate distribution space) and power output during time spans less than 30 s (Branch, 2003).

Therefore, the aim of this study was to investigate the influence of creatine supplementation on lactate accumulation following the 15-s all-out sprint test.

## 2. Materials and Methods

### *2.1. Subjects*

n=25 amateur cyclists and triathletes (19 male, 6 female, size 177±6cm, age 32±8y) were recruited for participation in the study. The study procedure was approved by the ethics committee of the Department of Sport Science of the University of Würzburg in accordance with the Declaration of Helsinki.

### *2.2. Design*

All participants underwent a familiarization trial first. A non-randomized crossover trial with placebo control incorporated a baseline measurement, 4x5g/d placebo (maltodextrin) and 4x5g/d creatine (Creapure, Alzchem AG, Trostberg, Germany) in that order.

### *2.3. Methodology*

Body composition was analyzed for every trial employing bioelectrical impedance analysis (inbody 720, BioSpace, Seoul, Korea). Capillary blood was sampled from the earlobe and analyzed employing the enzymatic-amperometric method (BioSen S-Line, EKF, Barleben, Germany). Lactate was measured twice before the sprint during the resting period and every minute for 8min directly following the sprint test. Participants warmed up for 10min with a load of 1.5 W/kg and then rested passively for 3min. Participants then performed an all-out sprint for 15-s on a Cyclus2 ergometer (RBM electronic, Leipzig, Germany) in isokinetic mode set to 130 rpm. $vLa_{max}$ was calculated as described in Heck & Schulz (Heck & Schulz, 2002) with alactic time set to 3.5 s for all tests.

### *2.4. Statistical Analysis*

All data was collected using Microsoft Excel. All analysis was performed using Gradphad Prism (v10.2). Differences between conditions were examined employing repeated-measures ANOVA. Confidence intervals for ANOVA analysis were set to 95%.

## 3. Results

Body mass (BM), fat-free mass (FFM), absolute mean power output ($P_{mean}$) increased significantly under the creatine condition. $P_{mean}$ normalized to FFM, the difference between resting and maximal lactate values (ΔLa), $vLa_{max}$ and total lactate accumulation (ΔLa multiplied by lactate distribution space (Mader & Heck, 1986)) displayed no significant differences between conditions. Results as mean±SD are shown in Table 1.

**Table 1.** Results as mean±SD for all relevant parameters under placebo and creatine condition

| parameter | placebo | creatine |
|---|---|---|
| BM [kg] | 72.2±9.4 | 72.8±9.5* |
| FFM [kg] | 62.9±8.4 | 63.9±8.5* |
| $P_{mean}$[W] | 860±177 | 889±185* |
| $P_{mean}$/FFM [W/kg] | 13.6±1.9 | 13.85±2.0 |
| ΔLa [mmol/l] | 8.59±2.25 | 8.78±2.74 |
| $vLa_{max}$ [mmol/l/s] | 0.75±0.20 | 0.76±0.24 |
| total lactate accumulation [mmol] | 523±152 | 532±184 |

* denotes a significant difference between conditions

## 4. Discussion

The differences between conditions in our study for body mass, fat-free mass and absolute power were expected and have been shown in numerous studies before. While the $vLa_{max}$-testing procedure may not ever be proven as a valid marker for the maximal glycolytic rate, there is no influence on the commonly used surrogate marker $vLa_{max}$. Neither relative values of concentration nor the absolute measures that consider fat-free mass as distribution space for lactate displayed significant differences. Combining these findings, this could imply that performance during the 15-s all-out sprint test is at least partially limited by glycolysis. Creatine supplementation and a resulting increase in available anaerobic substrates improves mean power output without a change in lactate production. However, changes in power output could also be caused by the mechanical effects and the increase in fat-free mass. These findings could provide the basis for further research.

## 5. Practical Applications.

Considering the practical relevance of creatine as ergogenic aid, its influence on parameters used for performance diagnostics represents important information. Our findings suggest that creatine supplementation does not change the implied glycolytic contribution as measured by capillary blood lactate during the standard $vLa_{max}$ testing procedure.

**Funding:** This research received no external funding.

**Acknowledgments:** Creatine and placebo were provided by Creapure/Alzchem AG free of charge.

**Conflicts of Interest:** The authors declare no conflict of interest. Creapure/Alzchem AG had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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