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Research Paper

Effect of Branched-Chain Amino Acid Supplementation on O_2 Uptake Kinetics and Time to Exhaustion in Trained Women

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ABSTRACT

Objective The aim of this study was to investigate the effect of Branched-Chain Amino Acid (BCAA) supplementation on O_2 uptake kinetics and the time to exhaustion in trained women.

Methods In this quasi-experimental study with pre-test/post-test design, participants were 20 trained women (Mean±SD age, 21.3±0.5 years). They were randomly assigned into two groups of BCAA (received 45mg/kg/d BCAA for 7 days; n=10) and isocaloric placebo (received 2g/d microcrystalline cellulose for 7 days; n=10). On day 7, subjects performed the incremental exercise test on a cycle ergometer until exhaustion in order to measure maximal oxygen uptake (Vo_2max). Respiratory gas exchange was measured using breath-by-breath analysis in order to evaluate O_2 uptake kinetics. Data were analyzed using one-way ANOVA with repeated measures at the significance level of P<0.05.

Results BCAA supplementation significantly increased Vo2max (P<0.04, 1.5±0.8 vs 1.9±0.5 min) and the time to exhaustion (P<0.02, 13.5±3.1 vs. 16.6±2.1 min) during the exercise test. The O_2 uptake kinetics such as oxygen deficit (P<0.01), time constant 1(P<0.02) and time constant 2 (P<0.01) in the BCAA group were faster than those in the placebo group.

Conclusion BCAA supplementation (45mg/kg/d) can speed up the O_2 uptake kinetics and may be effective in increasing the endurance capacity.

Extended Abstract

1. Introduction

The positive effect of Branched Chain Amino Acid (BCAA) supplements during resistance training is almost evident, and studies have shown that BCAA increases muscle mass and anabolic hormones, decreases muscle protein degradation during exercise, and increases the satellite cells proliferation; however, less study has been done on the effects of BCAA supplementation on endurance and anaerobic performance of athletes. In this regard, the aim of this study was to investigate the effect of BCAA supplementation on O_2 uptake kinetics and the time to exhaustion in trained women.

2. Materials and Methods

In this quasi-experimental study with pre-test/post-test design, participants were 20 trained women (Mean±SD age, 21.3±0.5 years) were selected using purposive sampling technique targeted. They were randomly assigned into two

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groups of BCAA (received 45mg/kg/d BCAA for 7 days; n=10) and isocaloric placebo (received 2g/d microcrystalline cellulose for 7 days; n=10). On day 7, subjects performed the incremental exercise test on a cycle ergometer until exhaustion in order to measure maximal oxygen uptake (Vo2max). The incremental exercise protocol included 3-min warm-up with zero watts at 50 rpm, the main activity for 30 min at 50 watts and increased by 30 watts per minute until exhaustion. Respiratory gas exchange was measured using breath-by-breath analysis in order to evaluate O_2 uptake kinetics. Individual responses during transition from baseline to exercise were plotted at 1 s intervals. The VO_2 response curve was fitted with a three-time exponential function (including amplitudes, time constants, and time delays) and the least-squares method for estimating nonlinear regression parameters. Data were analyzed using one-way ANOVA with repeated measures at the significance level of $P<0.05$.

3. Results

BCAA supplementation significantly increased Vo2max ($P<0.04$, 1.5±0.8 vs 1.9±0.5 min) and the time to exhaustion ($P<0.02$, 13.5±3.1 vs. 16.6±2.1 min) during the exercise test. The O_2 uptake kinetics such as oxygen deficit ($P<0.01$), time constant 1 ($P<0.02$) and time constant 2 ($P<0.01$) in the BCAA group were faster than those in the placebo group ($P<0.05$).

4. Conclusion

During transition from resting state to incremental exercise, the Adenosine 5′-Triphosphate (ATP) turnover, O_2 uptake, and O_2 utilization rate in skeletal muscles increase with a specified time until it reaches a steady state. The delay in reaching a steady state for O_2 uptake and its utilization in muscles (and mitochondrial oxidative phosphorylation) reflects metabolic capacity. This delay is mainly due to the slower metabolic pathways involved in oxidative phosphorylation (including the Krebs cycle and the electron transport chain) to modulate the increased oxygen flow to the muscle. Short-term supplementation with 0.45 g/kg/day BCAA probably improves the O_2 uptake kinetics and reduce the time to exultation of untrained young women while cycling on an ergometer.

According to studies, the possible mechanism for the improvement of aerobic capacity and O_2 uptake kinetics after BCAA supplementation is related to factors such as increased mitochondrial biogenesis, increased mitochondrial enzymes, and Krebs cycle intermediates.

Ethical Considerations

Compliance with ethical guidelines

In this study, all ethical principles including obtaining informed consent from participants, explaining research method to them, their right to leave the study at any time, and keeping their information confidential were observed.

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Authors' contributions

Conceptualization and investigation by Abbas Saremi and Fatemeh Abedi; Writing-Review & Editing: Abbas Saremi and Daryoosh Khajavi.

Conflicts of interest

The authors declared that no conflict of interests.

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