

The individual and combined effects of the angiotensin-converting enzyme gene insertion/deletion polymorphism and endurance training status on muscle oxygen saturation markers during incremental cycle ergometer test

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Introduction: The angiotensin-converting enzyme gene insertion/deletion polymorphism (ACE I/D genotype) has been one of the first and most investigated possible gene marker for physical performance. However, studies investigating the association between the ACE I/D genotype and peak oxygen uptake (VO_{2peak}) were not conclusive (Papadimitriou et al., 2018; Rankinen et al., 2000; Sonna et al., 2001). On the contrary, studies which have focused on skeletal muscle had more success (Valdivieso et al., 2017; Vaughan et al., 2016; Vaughan, Huber-Abel, Graber, Hoppeler, & Flück, 2013; Zhang et al., 2003). Muscle monitors based on near-infrared spectroscopy (NIRS) offer the possibility of non-invasive measurement of skeletal muscle oxygenation during exercise. Therefore, the aim of this study was to find out whether there are individual and combined effects of the ACE I/D genotype and endurance training status on markers of muscle oxygen saturation (SmO_2) during ramp test.

Methods: 21 non-specific trained subjects completed an incremental cycle ergometer test (ramp test) and were genotyped for the ACE I/D genotype. During ramp test VO_{2peak} was measured with a breath-by-breath system. SmO_2 of the *m. vastus lateralis* was measured using a NIRS device. The individual and combined effects of the ACE I/D genotype and endurance training status on SmO_2 markers during ramp test were analysed using two factor analysis of variance (ANOVA).

Results: ACE I/D genotype did not have a significant effect on any of the SmO_2 markers during ramp test. Endurance training status had a significant effect on the markers SmO_2_{min} ($p = 0.017$) and $\Delta_{deoxygenation}$ ($p = 0.033$) and a highly significant effect on the marker $\Delta_{1/2}$ reoxygenation ($p = 0.007$). In addition, there was a significant interaction effect between the ACE I/D genotype and training status on the marker $slope_{deoxygenation}$ ($p = 0.028$).

Discussion and Conclusion: Possible confounders, such as gender and training status, may have influenced a potential individual effect of the ACE I/D genotype. The observed greater muscle deoxygenation and reoxygenation in trained subjects could indicate an increased oxidative capacity of the *m. vastus lateralis*. The highly significant steeper $slope_{deoxygenation}$ for trained subjects only found within the I/I genotype could indicate a higher percentage of slow-twitch type I muscle fibres and thus a higher mitochondrial density. Based on these results it could be speculated that carriers of the I/I genotype could result in greater adaptability in a longitudinal training study. This pilot study may serve to obtain insightful data into the possibility of developing specific training programs *ad hoc* for different patient characteristics.

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