Submission reference	399
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Presentation preference	Oral
Topic	11- Physiology and Disease

Exercise induction of cellular and molecular adaptations in skeletal muscle of adult zebrafish

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In humans, exercise is increasingly recognized as an effective approach to prevent, among others, chronic conditions associated with metabolic alterations (i.e. obesity, T2DM, etc.) due to its effects on skeletal muscle. The zebrafish offers great potential to unravel the cellular and molecular adaptive mechanisms that underline the beneficial response to exercise. For this reason, in order to establish zebrafish as a model for exercise physiology, our group has previously determined the swimming economy of adult zebrafish and demonstrated that swimming at an optimal speed causes a significant increase in growth (Palstra et al., PloS ONE 5:e14483, 2010). In order to investigate the specific effects of swimming exercise on skeletal muscle, we have evaluated the cellular and molecular adaptive mechanisms in adult zebrafish subjected to sustained swimming. Our results show that swimming increases fibre size and capillarisation in skeletal muscle, demonstrating that muscle fibre hypertrophy may be responsible for the growth-promoting effects of exercise in zebrafish. Interestingly, the increase in capillarisation suggests that exercise may increase the oxidative capacity of skeletal muscle in zebrafish. Moreover, these functional changes in response to exercise are accompanied by a strong transcriptomic response in skeletal muscle. Specifically, the expression of genes involved in muscle growth and development, muscle contraction, metabolism, angiogenesis, apoptosis and the immune system is highly regulated by exercise. We believe that zebrafish is a useful model in exercise physiology with important implications in the fields of biomedicine and aquaculture.

Created/modified on 23/03/2013 18:55