Phenotypic variability in response to high-intensity interval training in the Gene SMART study

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Background: Virtually all exercise training studies have reported high inter-individual variability in response to specific training programs, leading to the identification of responders and non-responders to exercise training. However, the same individual could show a non-response for one phenotype and a response for another after an exercise intervention, which would result in them being classified as a non-responder for some variables and a responder for others. In addition, the accurate classification of responders and non-responders is not trivial. To identify a true response to training, it is necessary to compare the observed changes after training with changes that would have randomly occurred without training. Several methods to estimate this random variability have been proposed, including the calculation of technical error (TE) from repeated tests.

Aims: 1) To quantify the variability in response to four weeks of high-intensity interval training (HIIT) for selected physiological and molecular variables (*i.e.* W_{peak}, VO_{2max} and lactate threshold (LT)); 2) To use TE as a threshold to estimate the proportion of responders and non-responders to the selected phenotypes after four weeks of HIIT; 3) To test whether response in one variable correlates with the response in other variables.

Methods: This forms the preliminary results of the 69 participants who completed the Gene SMART (Skeletal Muscle Adaptive Response to Training) study, which aims to identify the genetic and molecular determinants of the variable response to training. Graded exercise tests separated by at least 48 h were performed in duplicates to estimate W_{peak}, VO_{2max} and LT before and after HIIT. Using the duplicate values for each variable, the TE (also called within-subject standard deviation) was calculated. Individuals showing changes above 2 x TE were classified as responders to the selected variables and individuals showing changes below 2 x TE were classified as adverse responders. Individuals showing changes between 2 x TE and 2 x TE were classified as non-responders.
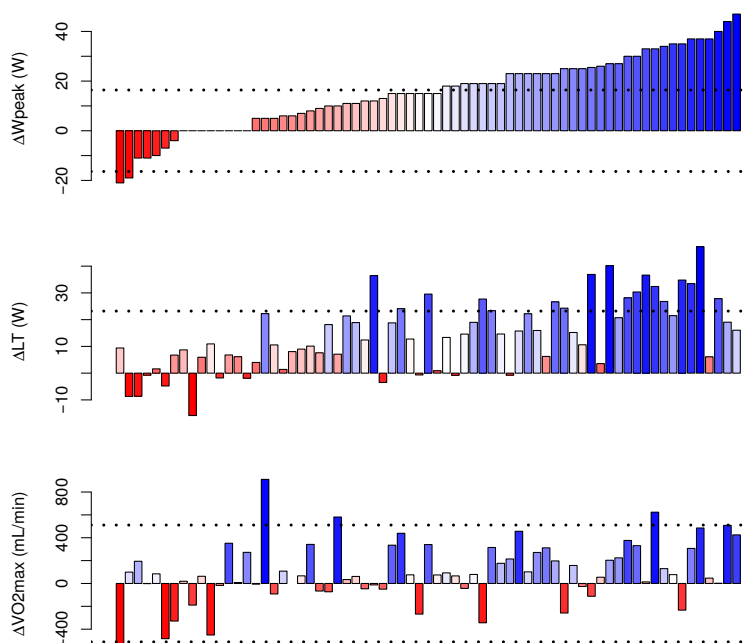
Results: We observed small increases in performance-related measures at the group level, but very large inter-individual variability after four weeks of HIIT (Figure 1). 47.8% of participants were responders for W_{peak}, 26.1% for LT, but only 4.3% for VO_{2max} (Figure 2). We observed a small percentage of adverse responses to the training program (Figure 2). Changes in W_{peak} correlated strongly with changes in LT ($\rho=0.64$, *P*<0.001), and moderately with changes in VO_{2max} ($\rho=0.35$, *P*=0.003). However, changes in LT correlated only weakly with changes in VO_{2max} ($\rho=0.26$, *P*=0.03).

ΔWpeak   ΔLT   ΔVO2max
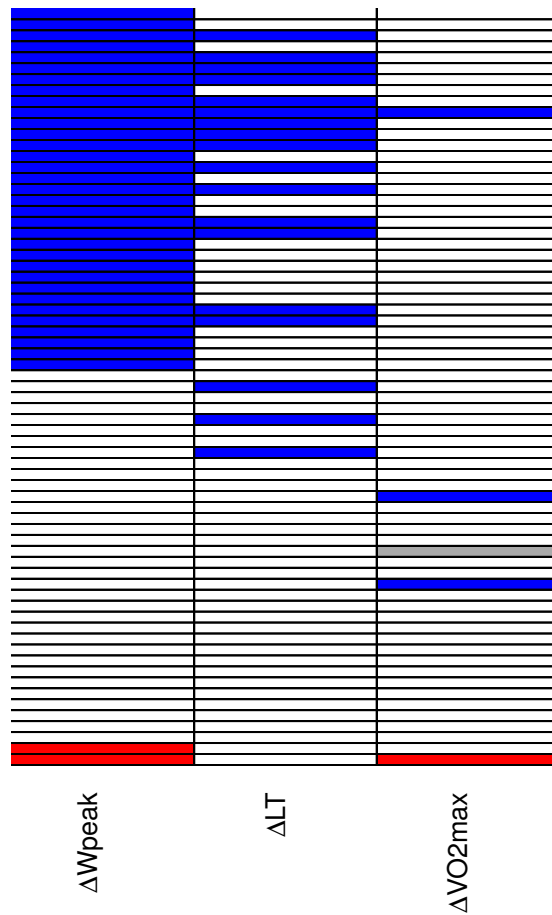
Conclusion: The inter-individual variability of training responses after four weeks of HIIT was very large, and the proportion of responders in the investigated variables varied from ~50% of responders for W_{peak} to only ~5% responders for VO_{2max}. Change in the investigated variables was not necessarily consistent, indicating that response to training may not occur for all performance-related measures at the same rate within the same individual.