

# Maximal Oxygen Consumption Predicts Skeletal and Heart Muscle Biomarkers Changes after a Full Distance Ironman

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**CONCLUSION:** Earlier research into predictors of biomarker changes after strenuous exercise has found contradictory results concerning age, sex and training experience. In the present Kalmar IronWoMan study  $VO_2$  max was found to be a good predictor of biomarker changes with higher  $VO_2$  max values being correlated to lower values for CK, NT-proBNP and MG.

## INTRODUCTION

Strenuous exercise like marathon or triathlon leads to disturbances of several biomarkers, not at least markers of skeletal and heart muscle damage. Different predictors of biomarker changes, e.g. sex, age and training experience have been discussed in the literature with contradictory results. To our best knowledge, maximal oxygen consumption ( $VO_2$  max) has not been investigated in this setting.

## PURPOSE

To evaluate predictors of biomarker changes in an Ironman triathlon.

## METHODS

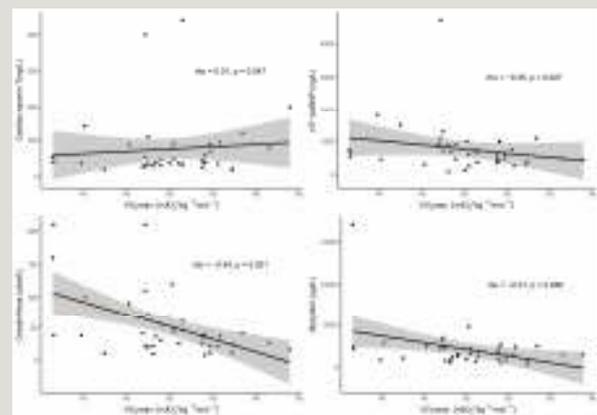
In 39 non-elite athletes (10 female, 29 male; age  $41.1 \pm 9.7$ , range 24-70 years) who had performed a 20 m shuttle run test to predict  $VO_2$  max, biomarkers (cardiac troponin T (cTnT; reference  $< 14$  ng/L), creatine kinase (CK; ref.  $< 1.9$   $\mu$ kat/L), myoglobin (ref.  $< 72$   $\mu$ g/L), and N-terminal prohormone of brain natriuretic peptide (NT-proBNP; ref.  $< 300$  ng/L) were measured by standard laboratory methods, ELISA, 7 days before, directly after, and day 1, and 7 after the race. For cTnT we, in addition, also measured on days 2, 3 and 4. Based on established sex and age cut-points we divided them into two groups in which those classified as very poor to excellent into "low" ( $n=19$ ) and those classified as superior "high" ( $n=20$ ).

## RESULTS

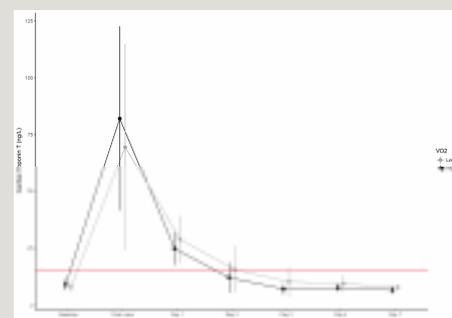
On average  $VO_2$ max was  $49.9 \pm 6.4$   $\text{mL O}_2^{-1} \cdot \text{kg}^{-1} \cdot \text{minute}^{-1}$ . Immediately post-race the mean  $\pm$  SD of the biomarkers were; Myoglobin  $2137 \pm 2614$   $\mu$ g/L, CK  $53 \pm 50$   $\mu$ kat/L, NT-proBNP  $772 \pm 2614$  ng/L, and cTnT  $75 \pm 89$  ng/L.

A negative association between  $VO_2$ max and NT-proBNP, CK and Myoglobin was observed (figure 1). cTnT leakage was non-significantly, in contrast to the other biomarkers, positively correlated with  $VO_2$ max.

The time to recover from the post-race value (cTnT) to normal appeared to go quicker in the high  $VO_2$ max group (figure 2).



**Figure 1** The figure show the association between  $VO_2$ max and the measured biomarkers immediately post-race. A linear model with 95 % confidence interval (shaded area) is also shown



**Figure 2** The figure illustrate the mean values (cTnT) at respective measurement point with the 95 % confidence interval showed by the whiskers by low or high  $VO_2$ max values. The red line indicate the upper clinical reference value



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