A Twin-Sibling Study and Meta-Analysis on the Heritability of Maximal Oxygen Uptake

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Introduction
Maximal oxygen uptake (VO\textsubscript{2max}) is defined as the highest rate of oxygen consumption during maximal intensity exercise performed until exhaustion and is considered a good index of endurance capacity. Direct measurement of oxygen consumption during the climax of a graded maximal exercise test is the golden standard to measure VO\textsubscript{2max}. VO\textsubscript{2max} can also be obtained using a submaximal exercise protocol, by extrapolating the HR/VO\textsubscript{2} curve to the predicted HR\textsubscript{max}.

This study aims to determine the relative contribution of genetic factors to the large individual differences in VO\textsubscript{2max} in childhood and adolescence.

Methods
In a sample of adolescent twins and siblings (N = 479), HR and VO\textsubscript{2} were recorded during the climax of a graded maximal exercise test on a cycle ergometer. In addition, VO\textsubscript{2max} was predicted in two graded submaximal exercise tests on a cycle ergometer and a treadmill, using extrapolation of the HR/VO\textsubscript{2} curve to the predicted HR\textsubscript{max}. Finally, a sample size weighted meta-analysis was performed on twin correlations obtained from all twin studies (including the current study) to arrive at a more robust estimate for the heritability of this crucial trait in exercise physiology.

Results
Heritability estimates ranged from 60% to 67% for VO\textsubscript{2max} in mL/min and 47% to 55% for VO\textsubscript{2max} in mL/min/kg (Figure 1).

Eight studies, including the current study, were meta-analyzed and resulted in a weighted heritability estimate of 60% (mL/min) and 64% (mL/min/kg) for VO\textsubscript{2max} (Figure 2).

Conclusions
The results of the current study, together with the results of the meta-analysis, confirm that innate factors determine more than half of the individual differences in the VO\textsubscript{2max} from childhood to young adulthood.