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

Nienke Schutte[12], Ineke Nederend[12], Meike Bartels[12], & Eco de Geus[12]

[1] Department of Biological Psychology, VU University Amsterdam, the Netherlands

[2] EMGO+ Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands

Introduction

Maximal oxygen uptake ($\dot{V}O_{2max}$) 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 $\dot{V}O_{2max}$. $\dot{V}O_{2max}$ can also be obtained using a submaximal exercise protocol, by extrapolating the HR/$\dot{V}O_2$ curve to the predicted HR_{max}.

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

Methods

In a sample of adolescent twins and siblings (*N* = 479), HR and $\dot{V}O_2$ were recorded during the climax of a graded maximal exercise test on a cycle ergometer. In addition, $\dot{V}O_{2max}$ was predicted in two graded submaximal exercise tests on a cycle ergometer and a treadmill, using extrapolation of the HR/$\dot{V}O_2$ curve to the predicted HR_{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 $\dot{V}O_{2max}$ in mL/min and 47% to 55% for $\dot{V}O_{2max}$ 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 $\dot{V}O_{2max}$ (Figure 2).

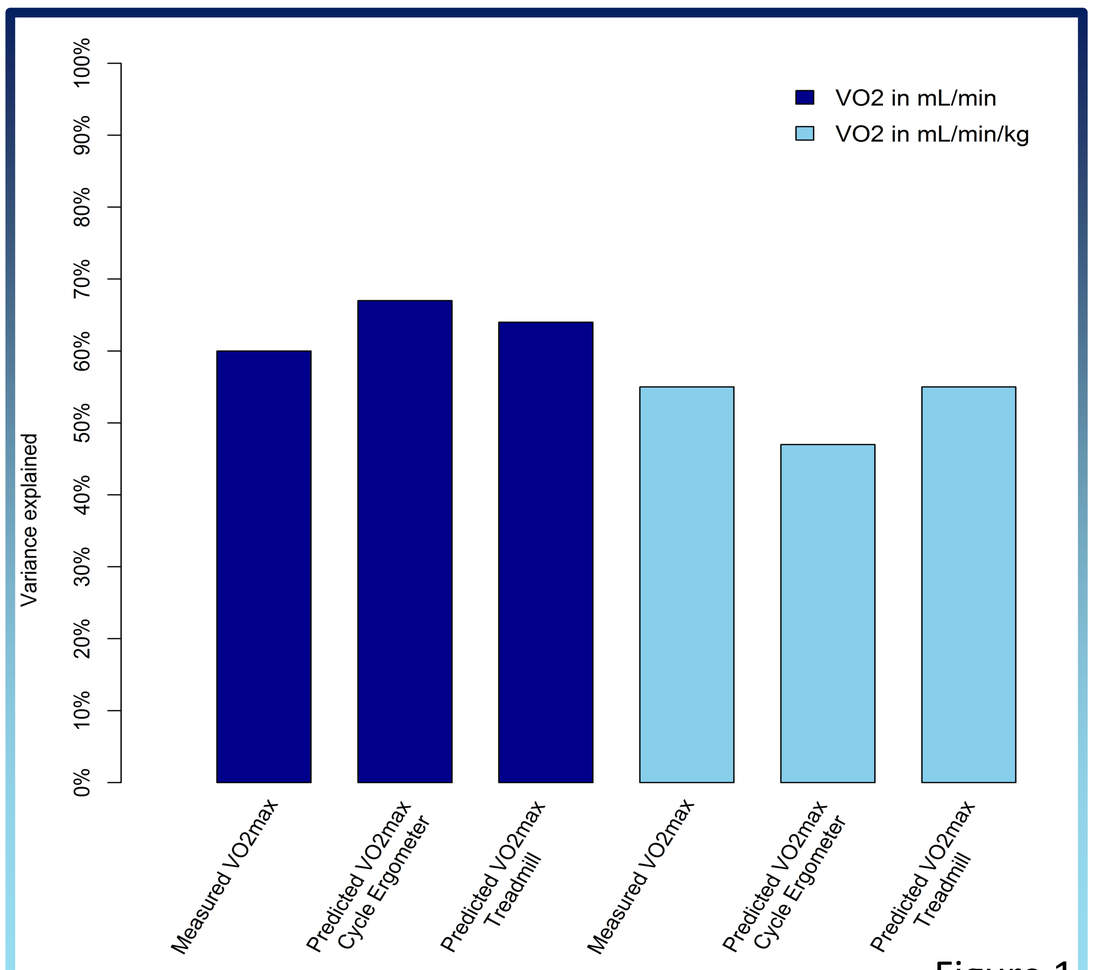

Figure 1

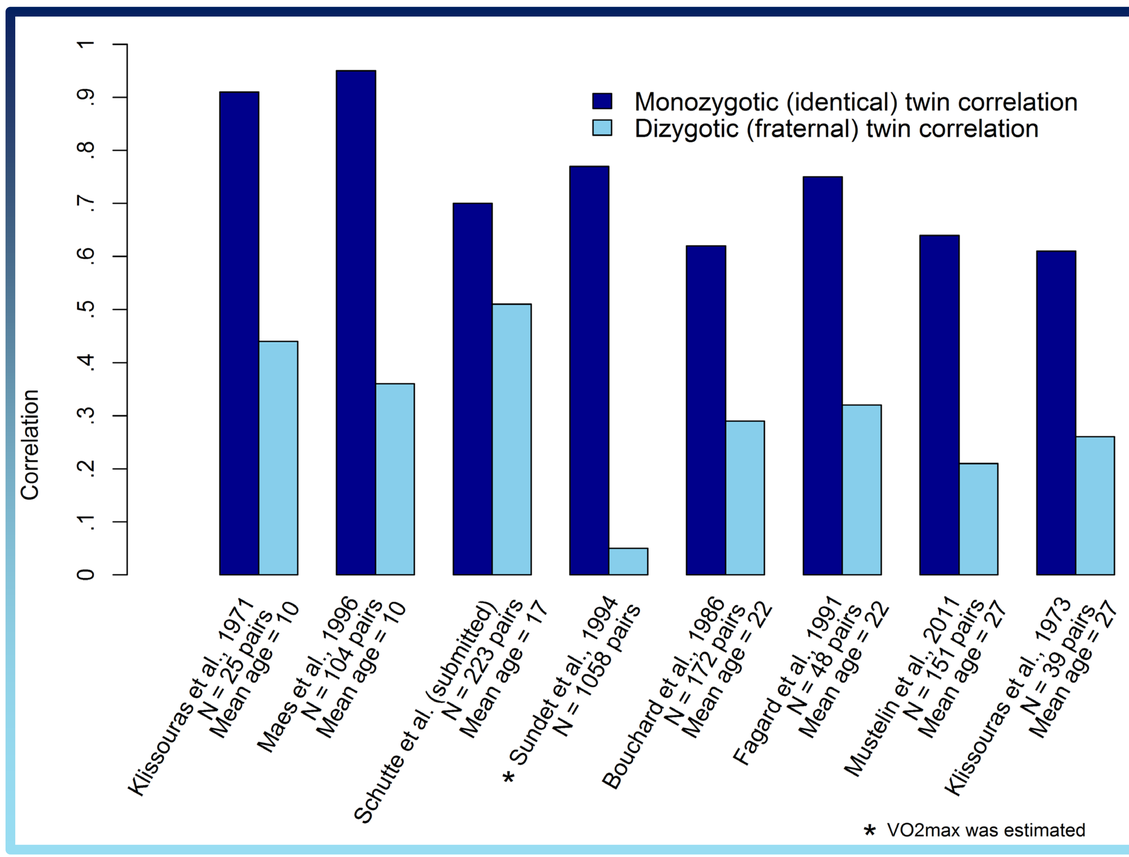

Figure 2

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 $\dot{V}O_{2max}$ from childhood to young adulthood.

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VUmc VU University Medical Center Amsterdam

EMGO+ Institute for Health and Care Research