A twin-sibling study on heritable determinants of voluntary exercise behavior

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Introduction

Despite the well-known benefits of physical activity, there is a growing number of adolescents and young adults with a less than optimal physically active lifestyle. To improve the success of interventions aimed to increase moderate to vigorous physical activity, we need to better understand the determinants of the extensive individual differences that are found in voluntary exercise activities. Figure 1 shows that with age, genetic effects become a dominant factor in explaining individual differences in voluntary exercise behavior.

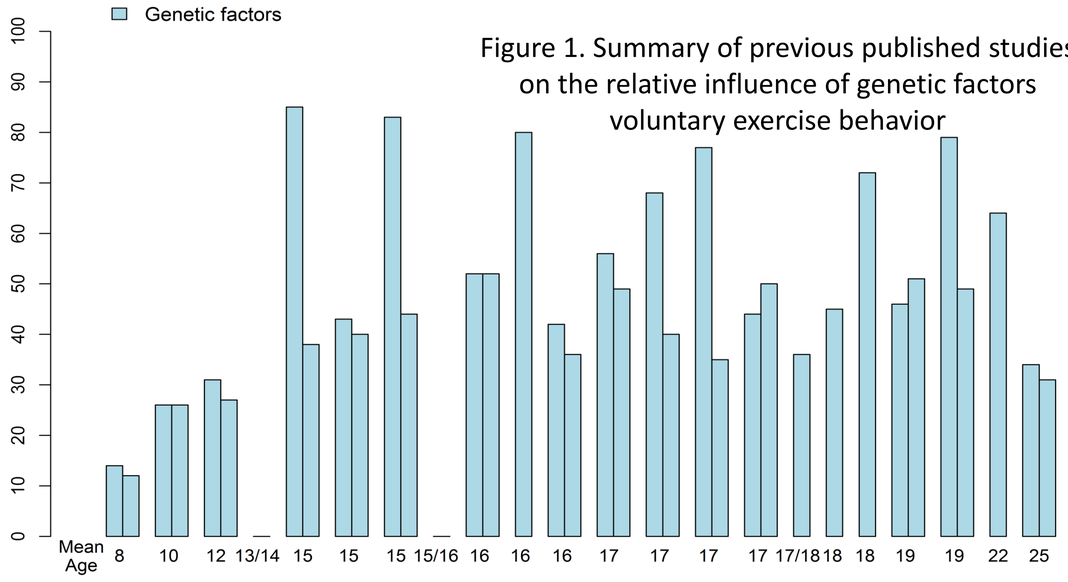


Figure 1. Summary of previous published studies on the relative influence of genetic factors voluntary exercise behavior

What gives rise to the high heritability estimates reported in late-adolescents and young adults?

Methods

A set of healthy adolescent twin pairs aged between 16 and 18 and their siblings from the Netherlands Twin Register were invited to participate in a study on the determinants of exercise behavior.

Figure 2. Time points and measurements of the cohort

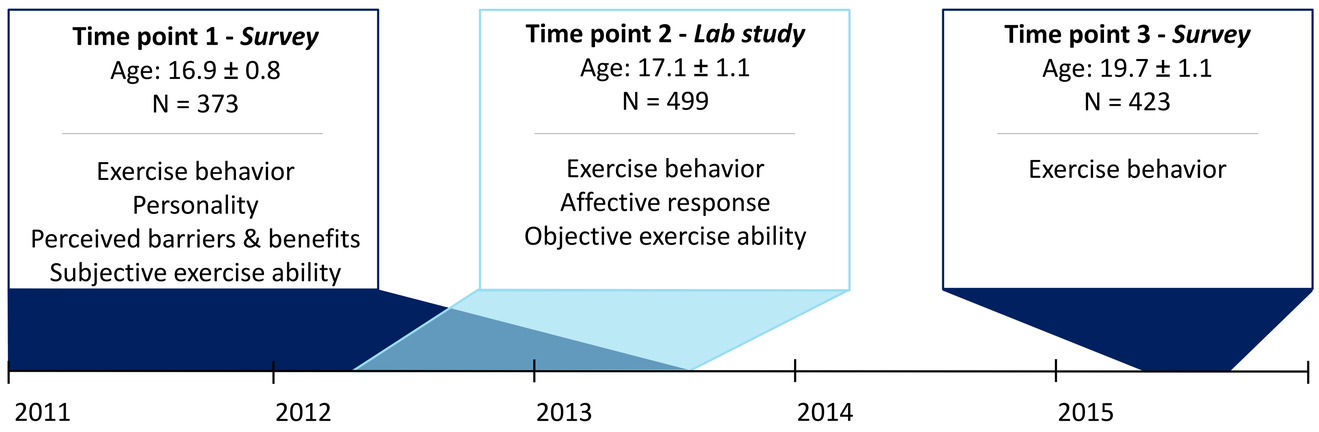
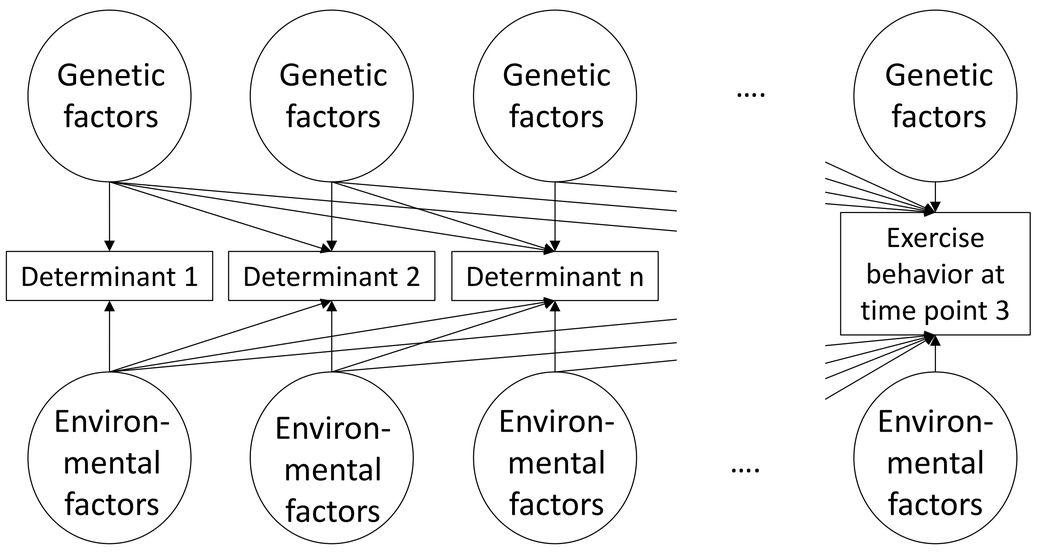


Figure 3. Graphic representation of the variance/covariance decomposition



Data on known determinants of exercise behavior were collected at different time points (Figure 2) using surveys and a laboratory study; personality, perceived barriers & benefits, subjective and objective exercise ability and the affective response to exercise. In a multivariate model, the phenotypic variance in these determinants and exercise behavior at time point 3 were decomposed in sources of genetic (co)variance and environmental (co)variance (Figure 3).

Results

The determinants that showed significant associations with exercise behavior at time point 3 are listed in Table 1. 60% of the individual differences in exercise behavior at time point 3 were due to genetic factors. Multivariate modeling showed that the prospective association between the determinants and exercise behavior at time point 3 reflected shared genetic factors: the genetic variation in exercise behavior is entirely explained by the genetic variation in the twelve determinants measured 2 years earlier.

Table 1. Phenotypic correlations with exercise behavior

Determinant	Phenotypic correlation
Extraversion	.25 (.14, .36)
Positive affect after exercise (Energy)	.14 (.03, .24)
Positive affect after exercise (Calmness)	.14 (.03, .24)
Benefits	.22 (.11, .32)
Lack of skills, support and/or resources	-.34 (-.44 -.23)
Time constraints	-.24 (-.34, -.13)
Lack of energy	-.32 (-.42, -.21)
Lack of enjoyment	-.39 (-.48, -.29)
Embarrassment	-.22 (-.33, -.11)
Subjective ability	.39 (.29, .49)
Maximal oxygen uptake ($\dot{V}O_{2max}$)	.33 (.22, .42)
Flexibility	.17 (.06, .29)

Conclusions

Taken their substantial predictive power we can assert that these determinants can be used to develop stratified interventions on adolescent and young adult exercise behavior. In addition, these results provide the first clues on 'where to look' for specific genes for voluntary exercise behavior.

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Nederlands Tweelingen Register

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