The dopaminergic reward system and leisure time exercise behavior:
A candidate allele study

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Nederlands Tweelingen Register

INTRODUCTION

Despite its benefits, regular leisure-time exercise behavior drops from childhood to adolescence and reaches unacceptable low proportions in adulthood, with the majority of people in the United States and Europe not engaging in regular exercise at the recommended level. Twin studies provide evidence that genetic influences contribute strongly to individual differences in leisure-time exercise behavior.

We hypothesize that part of this heritability is explained by genetic variation in the dopaminergic reward pathway that has, in animal models, been implicated in the adoption and maintenance of exercise activities due to its role in movement and reward responsiveness. A genetic association with exercise behavior was investigated for eight single nucleotide polymorphisms (SNPs) and three variable number of tandem repeats (VNTRs) with a functional effect on the dopaminergic reward system expected to increase sensitivity to rewarding effects of exercise (see Table 1).

METHODS

Data on exercise activities and at least one SNP/VNTR were available for 9,045 individuals aged 7 to 50 years old that are registered with the Nederlands Twin Register.

Exercise behavior was quantified as weekly metabolic equivalents of task (MET) hours spent on exercise activities. Mixed models were fitted in SPSS, with the following fixed effects: sex, age, sex by age interaction, and the respective SNP/VNTR. We corrected for genetic relatedness between family members by including a latent genetic factor as random effect.

Gene	Allelic variant (increaser/ decreaser)	N	Age (SD)	Mean and SD of weekly MET hours spent on leisure time exercise activities		
				Increaser allele homozygote	Hetero-zygote	Decreaser allele homozygote
DRD1	rs265981 (G/A)	7873	33.3 (12.1)	12.5 (17.5)	12.4 (18.2)	12.6 (18.2)
DRD2	rs6275 (A/G)	7734	33.2 (12.1)	13.4 (19.4)	12.4 (17.5)	12.4 (18.1)
	rs1800497 (A/G)	8756	32.5 (12.3)	14.5 (20.2)	13.2 (18.6)	12.9 (18.3)
DRD3	rs6280 (T/C)	7734	33.2 (12.1)	12.4 (17.2)	12.7 (18.7)	12.3 (18.3)
DRD4	rs1800955 (T/C)	2152	23.9 (11.3)	17.3 (22.5)	18.0 (22.3)	18.1 (21.3)
	7 allele/others	2476	23.3 (11.0)	15.8 (17.9)	19.7 (23.2)	18.3 (22.7)
DRD5	others/148 allele	2480	23.3 (11.0)	17.6 (23.0)	19.2 (22.3)	18.3 (23.0)
DBH	rs1611115 (T/C)	3140	24.4 (11.2)	15.9 (19.3)	18.2 (23.1)	18.0 (21.9)
	rs2519152 (T/C)	8139	32.8 (12.3)	13.5 (20.1)	12.6 (17.8)	12.5 (16.9)
DAT1	others/480 allele	2464	23.3 (11.0)	19.2 (21.1)	18.2 (20.8)	18.9 (24.2)
COMT	rs4680 (G/A)	8755	32.5 (12.3)	13.8 (18.6)	13.2 (18.7)	12.4 (18.0)

Table 1: Weekly MET hours (SD) for the three allelic combinations of each SNP/VNTR separately.

RESULTS

None of the SNPs/VNTRs were associated with exercise behavior (p> .02), despite sufficient power to detect even small effects.

CONCLUSION

We found no significant association between allelic variants involved in dopaminergic function and leisure time exercise behavior. Possible reasons for this include the fact that exercise behavior is a complex phenotype that is influenced by many genetic variants with very small effects, which may still include variants in the genes studied here. A plea is made for large genome-wide association studies to unravel the genetic pathways that affect exercise behavior in order to help personalize the strategies to increase this health-enhancing activity.

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