Short Communication

Association between substance use, personality traits, and platelet MAO activity in preadolescents and adolescents

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Abstract

This study examined the relationship between alcohol/illicit drug use, the Five-Factor Model (FFM) personality traits, aggressiveness (Agg), and hyperactivity (Hyp), and platelet monoamine oxidase (MAO) activity in a population-derived representative sample of preadolescents and adolescents ($n = 1172$). Alcohol and illicit drug use was self-reported. The FFM personality inventories were filled in by mothers of the participants, and Agg and Hyp were rated by their class teachers. Higher scores in extraversion (E), Agg, and Hyp and lower scores in conscientiousness (C) together with older age were significant predictors of more frequent alcohol use in adolescents. No significant association was found between alcohol illicit drug use, and platelet MAO activity.
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1. Introduction

Although a number of social, psychological, and environmental factors have been implicated in the aetiology of alcoholism, there is a growing body of evidence that

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personality and temperament are important determinants of vulnerability to becoming an alcoholic. Besides alcoholism, more frequent substance use in adolescents has been found to be related to a number of personality traits: these subjects are more aggressive, hyperactive, sensation seeking, impulsive, and have higher concentration difficulties (for review, see Chassin & DeLucia, 1996). During the last decades, the Five-Factor Model (FFM) of personality, which includes the dimensions of Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C) (McCrae & John, 1992) has become the norm against which different personality trait taxonomies are tested. It has been demonstrated that the same five dimensions can be measured in children and adolescents, demonstrating a remarkable stability through the course of development (Caspi & Roberts, 1999).

Platelet monoamine oxidase (MAO) activity is one of the most consistently reported biological correlates of personality and psychopathology. Low platelet MAO activity has repeatedly been found in alcoholics and drug abusers. Platelet MAO activity correlates with the same personality traits (sensation seeking, impulsiveness, monotony avoidance, anxiety, and extraversion) found to be related to heavy alcohol consumption or alcoholism (for review, see Oreland, 1993). Very little is known about the possible association of platelet MAO activity, personality, and behavior in children. af Klinteberg and Oreland (1995) have described a link between lower platelet MAO and higher hyperactivity (Hyp) and aggressiveness (Agg) in adolescents, but no attempt was made to measure substance use in that sample. Recently, it has been demonstrated that some compounds in cigarette smoke directly inhibit platelet MAO activity (Oreland et al., 1999). Thus, if the association between MAO and other variables is studied, it is necessary to consider the influence of smoking (Harro et al., 2001; Whitfield et al., 2000).

The aim of our investigation was to examine the relationship between alcohol/illicit drug use, FFM personality traits, Agg, Hyp, and platelet MAO activity in a population-derived representative sample of preadolescents and adolescents.

2. Methods

2.1. Subjects

Twenty-five schools were sampled using random numbers and probability proportional to the number of students in the school. From each school sampled, all third and ninth graders were invited to participate in the study. Children and their parents gave their informed consent. The participation rate was 76%. The main cause for not participating was the fear of venous blood sampling. The total number of subjects studied was 1172, including 581 children with mean age of 9.6 ± 0.5 years (ranging from 8 to 11 years) and 591 adolescents with mean age of 15.4 ± 0.6 years (ranging from 14 to 17 years). Permission for the study was obtained from the Committee of Ethics of the University of Tartu, Estonia.

2.2. Measures

Alcohol, illicit drug usage, and smoking habits were reported by the children. Personality traits according to FFM were obtained from mothers, while Agg and Hyp of students were rated by their class teachers.

Children reported if they had tasted alcohol and how often do they consume cider, beer, wine, and strong spirits. The frequency of the most often consumed type of alcohol ranging from 1 (*never*) to 5 (*everyday*) was used to form the total alcohol consumption score. The adolescents were divided into three groups: (1) nonconsumers (including those who had not tasted alcohol and those who had tasted but reported that they never use it), (2) moderate

Table 1
Alcohol consumption, experience with illicit drugs, smoking, and platelet MAO activity in participants

	Preadolescents				Adolescents			
	Boys ($n=278$)		Girls ($n=303$)		Boys ($n=260$)		Girls ($n=331$)	
	%	n	%	n	%	n	%	n
Alcohol								
Have not tried	55	153	63	191	5	14	6	19
Have tried	45	125	37	112	95	246	94	312
Nonconsumers	85	235	90	271	19	50	24	80
Moderate consumers	13	38	10	31	59	152	64	213
Frequent consumers	2	5	0	1	22	58	12	38**
Total alcohol consumption score[a]	1.2 ± 0.6	278	1.1 ± 0.4	303**	2.5 ± 1.1	260	2.2 ± 1.0	331****
Illicit drugs								
Have not tried	–[b]		–		94	240	95	308
Have tried	–		–		6	15	5	17
Illicit drug consumption score[a]	–[b]		–		1.08 ± 0.4	255	1.06 ± 0.3	325
Smoking								
Nonsmokers	92	255	96	292*	64	165	75	247****
Experimenters	7	21	4	11*	11	29	13	43
Smokers	1	2	0	0	25	66	12	40****
Platelet MAO activity (nmol $\times 10^{10}$ platelets$^{-1} \times$ min^{-1})[a]	8.48 ± 2.90	264	9.15 ± 2.38	279****	8.92 ± 2.81	257	10.14 ± 3.31	325**

[a] Mean $\pm$ S.D. is presented.
[b] Preadolescents was not asked about their experiences with illicit drugs.
* $P<.05$, statistically significant difference between boys and girls of the same age group according to χ^2 test and ANOVA.
** $P<.01$, statistically significant difference between boys and girls of the same age group according to χ^2 test and ANOVA.
**** $P<.0001$, statistically significant difference between boys and girls of the same age group according to χ^2 test and ANOVA.

consumers (who used alcohol less often than once per week), and (3) frequent (once per week or more often) consumers. In the younger age group, only two groups were formed: (1) nonconsumers and (2) alcohol consumers. Adolescents (not younger children) reported also how many times they had tried illicit drugs and if they were current users forming a score from 1 (*never tried*) to 4 (*I am a current user*). All participants were divided into three groups according their smoking habits: (1) nonsmokers, (2) experimenters (who smoked less often than once a week), and (3) smokers (smoking at least once per week).

Following an example of the ''Common Language'' California Child Q-Set (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994), a short 40-item questionnaire was constructed to measure personality traits according to the FFM. Each of the dimensions (N, E, O, A, and C) was measured using eight items in a five-point Likert format. Cronbach α's for the five factors were .73, .74, .52, .67, and .77, respectively. The constructed personality measure was previously validated against NEO-PI-R with which domains the convergent correlations ranged from .52 (A) to .71 (E).

Class teachers were asked to rate the participants' Agg, motor restlessness, and concentration difficulties in a seven-point scale previously used by af Klinteberg and Oreland (1995). The sum of the scores for motor restlessness and concentration difficulties was used as an indicator of Hyp.

Venous blood samples were taken after 12-h fasting into tubes with EDTA and platelet MAO activity was assessed according to the method previously described by us (Harro et al., 2001).

3. Results

In both age groups, boys had a significantly higher total alcohol consumption score, higher prevalence of smoking, and lower platelet MAO activity if compared with girls (Table 1).

Table 2
Mean ± S.D. scores of the FFM personality traits, Agg, and Hyp by age group and sex

	Age		Sex	
	Younger	Older	Boys	Girls
N	23.7 ± 5.0	22.1 ± 5.1****	22.8 ± 5.2	23.0 ± 5.0
E	29.3 ± 5.6	26.6 ± 5.3****	28.4 ± 5.6	27.7 ± 5.6
O	28.2 ± 4.0	26.8 ± 4.3****	27.5 ± 4.1	27.5 ± 4.3
A	28.0 ± 4.6	28.7 ± 4.8*	28.1 ± 4.7	28.6 ± 4.7
C	26.7 ± 5.4	28.2 ± 5.9****	26.9 ± 5.6	27.9 ± 5.8[##]
Agg	2.55 ± 1.48	2.80 ± 1.45***	3.10 ± 1.60	2.33 ± 1.25[####]
Hyp	5.74 ± 3.22	5.77 ± 3.00	6.77 ± 3.22	4.91 ± 2.74[####]

 * $P < .05$, significantly different from younger group.
 *** $P < .001$, significantly different from younger group.
 **** $P < .0001$, significantly different from younger group.
 [##] $P < .01$ significantly different from boys. No significant age and sex interaction was found.
 [####] $P < .0001$ significantly different from boys. No significant age and sex interaction was found.

Table 3
Spearman bivariate correlation matrix of all variables in preadolescents and adolescents

	AL	IL	MAO	N	E	O	A	C	Agg	Hyp	Smo	Sex	Age
AL	–	–	− .05	.08	.03	.01	− .09	− .06	.06	.07	− .03	− .08	.07
IL	.20$^{\#}$	–	–	–	–	–	–	–	–	–	–	–	–
MAO	− .06	.02	–	.01	.01	− .04	− .01	.08	− .07	− .03	− .05	.15**	.07
N	− .02	.02	− .01	–	− .18$^{\#}$	− .19$^{\#}$	− .37$^{\#}$	− .40$^{\#}$	.11*	.11*	.05	− .02	− .01
E	.15**	.06	− .03	− .14**	–	.46$^{\#}$	.05	− .03	− .02	.04	.07	− .06	− .04
O	.11*	.09*	.06	− .13**	.45$^{\#}$	–	.10*	.14$^{\#}$	− .04	− .02	− .01	− .03	.01
A	− .01	− .01	.06	− .44$^{\#}$	.001	.09*	–	.36$^{\#}$	− .20$^{\#}$	− .17***	− .04	.08	.01
C	− .08	− .08	.13**	− .49$^{\#}$	.02	.21$^{\#}$	.41$^{\#}$	–	− .27$^{\#}$	− .34$^{\#}$	− .04	.08	.06
Agg	.16$^{\#}$	.08	− .09*	.14**	− .01	− .09	− .10*	− .25$^{\#}$	–	.71$^{\#}$	.06	− .22$^{\#}$	.05
Hyp	.17$^{\#}$	.10*	− .16***	.18***	.06	− .08	− .09	− .28$^{\#}$	.68$^{\#}$	–	.10*	− .30$^{\#}$	.05
Smo	.41$^{\#}$	.20$^{\#}$	− .22$^{\#}$	.08	.12**	.01	− .002	− .27$^{\#}$	.31$^{\#}$	.35$^{\#}$	–	− .11*	.02
Sex	− .12**	− .02	.19$^{\#}$	.09	− .004	.07	.02	.11*	− .28$^{\#}$	− .31$^{\#}$	− .18$^{\#}$	–	− .13**
Age	.19$^{\#}$	.09*	− .09*	− .03	− .06	.05	.07	.03	.09*	.07	.11*	− .08	–

Results for preadolescents are presented above diagonal and adolescents below diagonal. AL: total alcohol consumption score, IL: illicit drug consumption, Smo: smoking, Sex: 1 = male and 2 = female, Age in years.

* $P < .05$.
** $P < .01$.
*** $P < .001$.
$^{\#}$ $P < .0001$.

Sex- and age-related differences of personality traits are presented in Table 2. A weak positive correlation was found between alcohol consumption and E, O, Agg, and Hyp in adolescents but not in preadolescents (Table 3). The correlation between illicit drug consumption and O and Hyp was also significant but very weak (Table 3). Platelet MAO activity correlated significantly and positively with C and negatively with Agg and Hyp only in adolescents. Nevertheless, if partial correlation was performed with smoking as a covariate, the correlation remained significant only between the score of Hyp and platelet MAO activity ($r = -.11$, $P < .05$).

If the participants were divided into groups according to their substance use, younger children, who reported to be consumers of alcohol, were given significantly higher scores in N and lower scores in A if compared with nonconsumers ($P < .05$, data not shown). Those 6% of adolescents who had not tried alcohol in their lives were given significantly lower scores in E ($P < .05$, data not shown) if compared with others. In adolescents, a dose-dependent relationship was found between three alcohol consumption groups, Agg and Hyp with those reporting to consume alcohol frequently showing the highest scores in Agg and Hyp ($P < .001$). Adolescents who had tried illicit drugs were given significantly higher scores in O and Hyp ($P < .05$, data not shown).

In adolescents, older age, higher E, and lower C (Table 4) were significant predictors for the total alcohol consumption score using multiple regression analysis. In two separate regression analysis, higher Agg and higher Hyp, both together with older age, were found to be significant predictors for the alcohol consumption. In preadolescents, only male sex was found to be a significant predictor for alcohol consumption (data not shown). If experience with illicit drugs was analysed as a dependent variable, only older age and lower C were

Table 4
Regression analyses for alcohol consumption score and experiences with illicit drugs with age, sex, and (a) the FFM of personality traits, (b) Agg, or (c) Hyp as independent variables in adolescents

Dependent variable	Adjusted r^2	F	df	Significant predictors	β	t
(a) Alcohol score	.07	6.46****	7/478	E	0.02	2.34*
				C	−0.02	−2.12*
				Age	0.37	4.69****
(b) Alcohol score	.06	11.94****	3/514	Agg	0.11	3.42***
				Age	0.27	3.60**
(c) Alcohol score	.06	11.59****	3/513	Hyp	0.05	3.25**
				Age	0.28	3.72***
(a) Experiences with drugs	.02	2.00^{ns}	7/470	C	−0.01	−2.00*
				Age	0.05	2.31*
(b) Experiences with drugs	.02	2.54^{ns}	3/504	Age	0.05	2.16*
(c) Experiences with drugs	.01	3.00*	3/503	Age	0.06	2.17*

ns: nonsignificant.
* $P < .05$, statistically significant.
** $P < .01$, statistically significant.
*** $P < .001$, statistically significant.
**** $P < .0001$, statistically significant.

significant predictors for illicit drug use in models including age, sex, FFM, and/or Hyp as independents (Table 4). Adding platelet MAO activity to any of these models did not change the significance or other parameters of the models (data not shown).

3.1. Limitations of the study

This study was cross-sectional and we cannot attribute causation to any associations found between substance use and personality traits. A longitudinal study (now going on) in the same children may give the answer to the question of causality between personality traits and alcohol use in adolescents.

4. Discussion

The results of previous research and our study clearly suggest that although there exists an association between personality traits and substance use, personality variables independently contribute only modestly to the prediction of such behaviors as alcohol and illicit drug use and smoking. Nevertheless, it is important to note that the association between personality traits and substance use can be found already in preadolescents.

We did not find any difference in platelet MAO between consumers and nonconsumers of alcohol or illicit drugs. It is possible that either systematic or random environmental factors are more important in determining early experimentation with substances than biological predispositions. It is conceivable that platelet MAO is rather a marker of vulnerability to abuse/addiction than of experimentation with drugs.

Because of the complex relationship between smoking behavior and personality on one hand and the direct effect of cigarette smoke on MAO activity (Oreland et al., 1999) on the other, the true relationship between platelet MAO, smoking, and personality traits associated with smoking can only be revealed in a prospective longitudinal study.

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