

Gender Differences in Cognitive and Personality Functioning in Patients With Substance Use Disorder

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The study was approved by the ethical committee of the A-Clinic Foundation. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation, institutional and national, and with the Helsinki Declaration of 1975, as revised in 2000 (5). Patients had informed consent of the aims of the study, and their participation was voluntary.

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The authors declare no conflict of interest.

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Abstract

Objectives:

Substance abuse is associated with impairments in cognition and many serious physical and behavioral consequences both in men and women. Gender differences, however, are not clear. The aim of this study was to examine gender differences in specific neuropsychological measures and personality variables in a sample of single and polysubstance patients.

Methods:

A total of 164 hospitalized patients—97 men and 67 women—underwent neuropsychological tests of verbal capacity, attention, speed of processing, perceptual reasoning, memory and learning, executive functioning, and inhibitory capacity. Personality was measured using the Minnesota Multiphasic Personality Inventory. Associations between neuropsychological measures, personality variables, and gender differences were studied using multiway analysis of covariance controlled for regular substance use in years, onset age of regular substance use, polysubstance use, and education level.

Results:

After adjustment, all the differences between men and women disappeared in the neuropsychological tests. Men reported higher values of somatisation and emotions of depression and anxiety than women. Men were also more suspicious and elicited more disturbed thinking than women.

Conclusions:

Contrary to previous studies, women are not more vulnerable to the effects of substance use compared with men. Notably, men are more vulnerable to negative emotions than women.

Key Words: substance abuse, gender differences, inpatients, neuropsychological functions, personality

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There is a growing general awareness of substance abuse in women and the importance of gender in medical research and treatment. Biological and psychological differences between men and women may manifest differently in the cognition and personality of those

with substance use disorder (SUD). Women have been found to be more susceptible than men to alcohol's effects on behavioral and cognitive functions.¹ Evidence suggest that females are more impaired in tasks of executive functions,^{2,3} visual memory,³ and wechsler adult intelligence scale (WAIS) scores.⁴ In contrast, gender does not appear to influence the impairment of cognitive functions in tests of memory, attention, visuospatial ability, and language in the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS).⁵ In addition, men and women do not differ in the Montreal Cognitive Assessment (MoCA); there are no differences in visuospatial and executive functions, memory, attention, language, and delayed recall tests.⁶

Differences in personality factors between males and females with alcohol and substance users have been marginally examined. Mulder reviewed personality-based explanations in alcoholism research, interest in which increased in the 1980s. It appeared that patients with alcohol use disorder who also abuse other substances have different personality characteristics from those who do not.⁷ Individuals who abuse other substances are younger, more impulsive, disinhibited, and extroverted. Moreover, studies have shown that personality may be an important mediator of the genetic effects of alcoholism. The majority of studies have centered on antisocial personality disorder and conduct disorder, while others have focused on normally distributed personality disorders. Studies have found a clear association between antisocial behavior and alcoholism;

measures of impulsivity or novelty seeking appeared less predictive. In women, high negative emotionality may predate alcoholism. Nevertheless, personality variables explain a small proportion of the risk of dependence. Vulnerability to alcoholism is increased by poorer educational achievement, deviant peers, and general disadvantage.⁷

The results of a study of the Minnesota Multiphasic Personality Inventory (MMPI) profiles indicated that scale 4 (ie, psychopathic deviance) is likely to be elevated in individuals who abuse substances.⁸ Scale 4 is typically not significantly elevated in medical patients. The 24/42 (ie, depression-psychopathic) 2-point code type is found in men with alcohol use disorder. This same code type and the 46/64 (ie, psychopathic-paranoia) code type are often found in women with alcohol use disorder. Neither of these code types is common in other medical patients who do not abuse alcohol.

Gender differences in comorbidity are also important. The prevalence of personality disorders in alcoholism ranges from as low as 22% to 40% to as high as 58% to 78%.⁹ Anxiety and mood disorders are the most prevalent comorbid disorders in women with alcohol use disorder, whereas substance abuse and antisocial personality disorders are most frequent in men with alcohol use disorder. In a large sample, women diagnosed with borderline personality disorder more often than men, whereas men had higher rates of antisocial and narcissistic personality disorders than women.¹⁰

Previous studies have not ruled out the fact that the worst neuropsychological performance of men and women is limited to premorbid cognitive differences and education nor have they considered the impact of the onset age of regular substance use on differences in personality characteristics between men and women. The present study examined (1) the cognitive and personality differences between men and women; (2) the impact of education level, duration of regular substance use, and singlesubstance and polysubstance use on cognition; and (3) the impact of education level, onset age of regular substance use, and singlesubstance and polysubstance use on personality characteristics.

METHODS

Participants

This research is a retrospective cross-sectional study. Data was collected from patients of Järvenpää Addiction Hospital who underwent neuropsychological examination in 2004 to 2012. An abstinence period of one month was required before testing, given the longer-lasting, subacute cognitive, and neural effects of cannabis.

The inclusion criteria were as follows: (1) aged 18 to 65 years, (2) native Finnish speakers with a substance use diagnosis, and (3) minimum of one month of abstinence. Meanwhile, the exclusion criteria were as follows: (1) younger than 18 years old; (2) human immunovirus-positive patients or those having other chronic diseases possibly affecting the central nervous system; and (3) history of neurological disorder, opioid substitution treatment, or epileptic seizures.

The study group consisted of 164 hospitalized patients with SUD, both men ($n=97$) and women ($n=67$). No gender differences were found in age, level of education, learning difficulties, or polysubstance use. Duration of regular substance use was significantly longer in men than in women. This variable was controlled in later statistical analyses (Table 1).

The majority of subjects used alcohol as a singlesubstance, with (89.4% among men and 80.0% among women). About half of the men (48%) and more than half of the women (55%) were polysubstance users. The majority of polysubstance users abused alcohol (ie, 80.0% among men and 62.2% among women) in addition to sedatives, cannabis, opioids, and stimulants.

Experienced psychiatrists made the diagnoses following the criteria of ICD-10 based on all available information at the time of discharge. SUD diagnoses also included alcohol overuse or dependence. Data on the years of regular substance use was obtained from medical records, medical examinations, and interviews with a nurse and a social worker.

The study was approved by the ethical committee of the A-Clinic Foundation

TABLE 1. Sociodemographic and Clinical Data of the Men and Women Populations

	N	Men, N = 97, n (%)	Women, N = 67, n (%)	Statistical Test	Men vs. Women <i>P</i>
Age (mean, SD)	164	38.39 (9.73)	38.72 (12.77)	<i>t</i> test	0.86
Gender	164	97 (59.1)	67 (40.9)	χ^2	0.46
Education level					
No primary school		—	—		
Primary school		36 (37.1)	29 (43.3)		
Vocational training		39 (40.2)	15 (22.4)		
College-level education		15 (15.5)	13 (19.4)		
Higher education	164	7 (7.2)	10 (14.9)	χ^2	0.077
Learning difficulties	164	42 (43.3)	28 (41.8)	χ^2	0.85
Substance use duration, years (mean, SD)	164	17.8 (8.9)	13.0 (8.6)	<i>t</i> test	0.001***
Polysubstance users	90	53 (54.6)	37 (55.2)	χ^2	0.94

****P*<0.001.

(23.1.2013). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation, both institutional and national, and the Helsinki Declaration of 1975, as revised in 2000 (5). Patients had informed consent of the aims of the study, and their participation was voluntary.

MEASURES

Neuropsychological Assessments

Neuropsychological testing was conducted as part of a work clinical assessment and a treatment plan assessment by the first author who is experienced in using the methods. Table 2 presents all neuropsychological measures.

The computerized CogniSpeed tasks¹¹ were used to measure simple reaction time and automatic and conscious information processing. The Simple Reaction Time subtest of the computerized CogniSpeed test battery was performed first. Inhibitory capacity was assessed by the CogniSpeed version of the Stroop Color-Word Test.¹² The test has 3 subtests: (1) Neutral Condition (COL), (2) Congruous Word Condition CON, and (3) Incongruous Word Condition (IN). COL and CON are related to more automatic information

processing, while IN involves more conscious and effort-intensive processing. The Total Stroop Effect is the difference between reaction times in CON and IN, whereas Stroop Interference is the difference between reaction times in IN and COL.

Studies have confirmed that the CogniSpeed software is a sensitive instrument for measuring the performance of healthy participants and patients with brain disease.^{11,13,14}

Personality Assessment

Personality variables were measured using the subscales of the MMPI, namely hypochondriasis, depression, hysteria, psychopathic deviate, masculinity-femininity, paranoia, psychasthenia, schizophrenia, and hypomania scales.^{8,15}

Statistical Analyses

The sociodemographic data of the 2 patient groups were compared using the Student *t* test and Mann-Whitney *U* test for continuous measurements and the χ^2 test or the Fisher exact test for categorical variables. For statistical comparisons, *P*<0.05 was considered statistically significant.

Analysis of covariance was used to study associations between

TABLE 2. Neuropsychological Measures

Cognitive Domain	Test	Score Units
Premorbid IQ	Vocabulary (WAIS-R; Wechsler, 1975)	Standard score
Attention	Digit Span Forward	Total raw score, max 12
	Digit Span Backward	Total raw score, max 12
Speed of Processing	Digit Symbol (WAIS-R; Wechsler, 1975)	Standard Score
	Simple reaction time (CogniSpeed; Revonsuo et al, 1993)	Time to complete (ms)
Perceptual Reasoning	Block Design (WAIS-R; Wechsler, 1975)	Standard Score
	Raven Standard Matrices (Raven, 2004)	
Verbal Memory and Learning	Verbal subtests of the WMS-R (Wechsler, 1987)	Verbal Memory Index
	Immediate Logical Memory	Total raw score, max 50
	Delayed recall of Logical Memory	Total raw score, max 50
	Immediate Associate Learning	Total raw score, max 24
	Delayed recall of Associate Learning	Total raw score, max 8
Visual Memory and Learning	Visual subtests of (WMS-R (Wechsler, 1987)	Visual Memory Index
	Immediate Visual Learning	Total raw score, max 18
	Delayed recall of Visual Learning	Total raw score, max 6
	Immediate Visual Reproduction	Total raw score, max 41
	Delayed recall of Visual Reproduction	Total raw score, max 41
Delayed Memory	WMS-R (Wechsler, 1987)	Delayed Memory Index
Inhibitory Capacity	CogniSpeed version of the Stroop Color-Word Test (Stroop, 1935)	Time to complete (ms), and number of errors
	Neutral Condition, COL	
	Congruous Word Condition, CON	
Executive Function	Incongruous Word Condition, IN	
	CogniSpeed version of the Stroop Color-Word Test (Stroop, 1935)	Time to complete (ms)
Total Stroop (IN-CON)		
Stroop Interference (IN-COL)		

IQ indicates intelligence quotient; WAIS, wechsler adult intelligence scale.

neuropsychological measures and men and women populations, controlling for education level, regular substance use in years, polysubstance use (yes/no), and calendar age. Analysis of covariance was also used to study associations between personality variables and men and women populations, controlling for education level, polysubstance use (yes/no) and onset age of regular substance use. Explanatory variables and interactions that

do not significantly affect the primary outcome were removed from the analysis. Every neuropsychological measurement was analyzed separately. Model-based means were also presented. Logarithmic transformation was used for simple reaction time, IN and COL to achieve normal distribution assumption for residuals. Data was analyzed by using the Statistical Package for Social Sciences software (SPSS Inc., Chicago, IL) and the

SAS System version 9.4 for Windows
(SAS Institute Inc., Cary, NC).

RESULTS

Analyses of Covariance of Neuropsychological Tests

The primary differences between men and women in the neuropsychological tests are presented in Table 3.

There were significant differences between men and women in a test of Vocabulary of WAIS-R, the Digit Symbol test, and the Raven test. Women performed better in the Vocabulary test and were faster in the Digit Symbol test, while men performed better in the Raven test indicating better skills in perceptual reasoning. Performance in the Digit Symbol test was, however, below normal average for both men and women. Tests of visual memory and learning and delayed memory were also below average in both men and women. Men were clinically below average in tests of Visual Memory Index. Both men and women were as slow as 63-year and 64-year olds in tasks of Stroop Congruence and Incongruence.¹²

Neuropsychological tests were separately tested, adjusting for calendar age, education level, polysubstance use, and years of regular substance use. Calendar age was adjusted with neuropsychological test without age correction as CogniSpeed tasks of simple reaction time, COL, CON, and IN. In addition, age was adjusted with tests of WAIS-R using original data of raw scores (ie, Digit Span Forward and Backward tests, and Block Design test).

After adjustment, all the differences between men and women disappeared, and there were no correlations nor interactions with substance use variables (ie, duration of regular substance use and multidrug use) or background variables (ie, education level).

Analyses of Covariance of the Personality Test of MMPI

Personality tests were separately tested, adjusting for education level, polysubstance use, and onset age of

regular substance use. Men and women differed in almost all scales. Table 4 outlines the primary differences between men and women and the results of multiway analysis of covariance.

The interpretations of the score levels of scales are based on Graham.⁸ Both men and women scored moderately high ($T=60-80$) on all clinical scales. Only women scored below 60 in the masculinity-femininity scale. The elevation of the *F* scale, combined with the normal range scores on *L* and *K*, may suggest overreporting, but significant pathology may still be present.

Gender was significantly associated with depression, psychasthenia, hysteria, schizophrenia, hypochondriasis, and masculinity-femininity. Using education level, onset age of regular substance use, and polysubstance use as covariables, significant differences between men and women remained. With education level as a covariable, significant differences were found in hypomania. With onset age of regular substance use as a covariable, significant differences were found in masculinity-femininity. Accordingly, earlier onset of regular substance use was associated with both lower and higher scores, while *T*-score values tended to diminish with later onset age. With polysubstance use as covariable, significant differences were found in paranoia, psychasthenia, and hypomania. Polysubstance use was also associated with higher paranoia, psychasthenia, and hypomania.

The Validity Scale of *K*-correction correlated significantly with gender. Women scored higher than men. Using onset age of regular use as a covariable, significant differences were found in the validity Scale of Lie. Later onset age of regular use was associated with the higher *T*-score, while the Validity Scale of Infrequency correlated significantly with polysubstance use. Polysubstance users scored higher than patients without polysubstance use.

DISCUSSION

The present study examined cognitive and personality differences between

TABLE 3. Group Comparisons of Neuropsychological Measures

Cognitive Domain	Men, N = 95		Women, N = 67		P (t test)
	N	Mean (SD); Median (Interquartile Range: 25%-75%)	N	Mean (SD); Median (Interquartile Range: 25%-75%)	P (Mann- Whitney U test)
Premorbid IQ					
Vocabulary	95	8.36 (2.6)	67	9.33 (2.8)	0.026*
Attention					
Digit span forward	95	5.95 (1.1)	67	6.00 (1.0)	0.76
Digit span backward	95	4.60 (1.1)	67	4.69 (1.0)	0.62
Speed of processing					
Digit symbol	54	4.31 (2.7)	46	5.70 (2.7)	0.012*
Simple reaction time					
Dominant hand	92	368.0 (335.8-454.8)	61	378.0 (325.5-453.0)	0.93
Nondominant hand	89	362.0 (328.0-427.0)	61	389.0 (335.5-467.0)	0.38
Perceptual reasoning					
Block design	33	7.85 (3.6)	31	8.23 (2.8)	0.64
Raven	88	102.67 (14.4)	60	95.82 (11-7)	0.003**
Verbal memory and learning					
Verbal memory index	42	93.62 (16.8)	25	99.00 (17.0)	0.21
Immediate logical memory	42	24.00 (8.9)	25	26.92 (7.6)	0.18
Delayed logical memory	41	19.15 (9.4)	35	23.08 (7.6)	0.87
Immediate associate learning	42	16.40 (4.5)	25	18.12 (5.4)	0.17
Delayed associate learning	41	6.54 (2.9)	24	6.75 (1.5)	0.74
Visual memory and learning					
Visual memory index	40	77.38 (22.0)	25	81.52 (21.6)	0.46
Immediate visual learning	41	10.59 (6.9)	24	12.33 (5.6)	0.30
Delayed visual learning	40	4.18 (1.8)	24	4.79 (1.9)	0.19
Immediate visual reproduction	42	34.38 (5.4)	25	34.48 (3.9)	0.94
Delayed visual reproduction	41	28.32 (9.9)	24	28.08 (9.0)	0.93
Delayed memory					
Delayed memory index	40	79.43 (22.8)	25	86.08 (18.9)	0.23
Inhibitory capacity					
Neutral Condition (COL)					
COL ms	92	575.5 (493.3-714.3)	61	561.0 (484.5-632.0)	0.54
COL errors	92	1.0 (0.3-3.0)	61	1.0 (0.0-2.0)	0.05
Congruous Word Condition (CON)					
CON ms	92	539.0 (485.8-641.5)	61	542.0 (464.5-625.0)	0.40
CON errors	92	1.0 (0.0-2.0)	61	1.0 (0.0-2.0)	0.17

TABLE 3. (continued)

Cognitive Domain	Men, N = 95		Women, N = 67		P (t test)
	N	Mean (SD); Median (Interquartile Range: 25%-75%)	N	Mean (SD); Median (Interquartile Range: 25%-75%)	P (Mann- Whitney U test)
Incongruous Word Condition (IN)					
IN ms	91	686.0 (550.0-921.0)	61	642.0 (569.0-839.5)	0.88
IN errors	91	1.0 (0.0-4.0)	61	2 (0.0-4.0)	0.55
*P<0.05.					
**P<0.01.					
IQ indicates intelligence quotient.					

men and women; assessed the impact of education level, duration of regular substance use in years, and singlesubstance and polysubstance use on cognition; and evaluated the impact of education level, onset age of regular substance use, and singlesubstance and polysubstance use on personality features in a sample of hospitalized addiction patients with a diagnosis of SUD.

Men and women did not differ in any of the sociodemographic variables studied. Moreover, they did differ in clinical variables. The duration of regular substance use among men was longer than that of women. The effect of this variable was controlled in the statistical analyses.

Significant differences between men and women in the primary neuropsychological tests were observed. Women had better vocabulary, and they were faster than men in the test of psychomotor speed. In contrast, men performed better than women in perceptual reasoning. After controlling the effects of education level, duration of regular substance use, polysubstance use, and calendar age, all the differences between men and women disappeared, and there were no correlations nor interactions with substance use variables. The results do not support the findings of previous studies that women's cognitive functions are more susceptible to the effects of alcohol and substance use than men's.

Several differences were noted between men and women in personality variables. Controlling for the impact of

education level, onset age of regular substance use, and polysubstance use, men reported more severe personality and emotional problems than women in the scale values of depression, psychasthenia, hysteria, schizophrenia, hypochondriasis, and masculinity-femininity. Men also had higher scores than women in the depression scale. In the psychasthenia scale, men tended to be more anxious, tense, and agitated than women. In the hypochondriasis and hysteria scales, men perceived themselves more often than women as physically ill, and they tended to lack insight into the somatic symptoms or indications of the psychological components of their conditions. Similarly, men's schizophrenia scale values were significantly higher than women's values, suggesting the possibility of psychotic disorder, confusion, disorganization, and disorientation. In the masculinity-femininity scale, men had higher values than women, indicating a lack of stereotypically masculine interests. Women's values were indicative of interests that tended to be stereotypically more masculine than feminine. *K*-correction scale values (ie, a validity scale) were higher in women, suggesting that women denied symptoms and problems more than men do.

Personality differences between male and female participants in this study did not support previous findings concerning negative emotionality. Previous studies have found that women with high negative emotionality, anxiety, and depression are more susceptible to alcoholism than men.^{7,9,16} In this

TABLE 4. Results of Multiway Analysis of Covariance of the Associations Between Personality Variables of Minnesota Multiphasic Personality Inventory, Gender, and Covariables

Personality Variables	Gender Differences		Gender and Covariables							
	Men, N = 97	Women, N = 67	Gender		Education Level		Onset Age of Regular Use		Polysubstance Use	
Clinical Scales	Mean (SD)	Mean (SD)	$F_{1,41}$	P	$F_{1,41}$	P	$F_{1,41}$	P	$F_{1,11}$	P
Hypochondriasis (Hs)	75.85 (16.10)	69.05 (12.61)	6.98	0.0092*	0.31	0.82	0.00	0.95	0.49	0.48
Depression (D)	91.89 (18.58)	77.80 (16.65)	18.84	<0.0001***	0.43	0.73	0.62	0.43	0.36	0.55
Hysteria (Hy)	74.21 (13.13)	68.34 (10.64)	8.55	0.0040**	1.23	0.302	0.16	0.69	2.71	0.102
Psychopathic Deviate (Pd)	80.27 (15.40)	78.19 (13.43)	0.27	0.61	1.41	0.24	1.02	0.32	3.44	0.066
Masculinity-Femininity (Mf)	63.38 (10.28)	57.97 (14.22)	4.90	0.028*	1.12	0.34	5.73	0.018*	0.32	0.57
Paranoia (Pa)	76.11 (15.68)	71.36 (11.87)	2.87	0.093	1.12	0.34	0.00	0.97	5.33	0.023*
Psychasthenia (Pt)	84.84 (19.01)	73.20 (13.00)	14.20	0.0002**	0.06	0.98	0.04	0.84	4.23	0.041*
Schizophrenia (Sc)	87.37 (21.79)	75.98 (14.72)	11.26	0.0010**	1.92	0.13	0.02	0.88	3.06	0.082
Hypomania (Ma)	63.78 (13.52)	67.12 (12.74)	2.99	0.086	3.41	0.019*	0.18	0.67	9.22	0.0029**
Social Introversion (Si)	65.43 (13.26)	63.24 (15.88)	0.88	0.35	1.35	0.26	0.00	1.00	0.67	0.42
Validity scales										
Lie (L)	47.26 (7.36)	50.71 (10.96)	3.20	0.076	0.15	0.93	4.70	0.032*	0.95	0.33
Infrequency (F)	79.28 (16.52)	74.34 (14.48)	2.33	0.13	2.41	0.070	0.74	0.39	6.00	0.016*
K-correction	50.11 (8.20)	56.17 (13.00)	10.78	0.0013**	0.91	0.44	0.01	0.90	0.19	0.66

*Correlation is significant at the level 0.05.

**Correlation is significant at the level 0.001.

***Correlation is significant at the level <0.000.

study, men had more characteristics of negative emotionality, such as depression, anxiety, tension, and disorganized thinking. Expectations of men in their roles as the main breadwinner of the family remained strong. Failure in these expectations caused more anxiety and depression in men than in women.

Similarly, personality differences between male and female participants in this study did not align with previous findings concerning paranoia and psychopathic personality characteristics. There was no significant difference between men and women in scales of psychopathic deviate and paranoia. The result of the paranoia scale was unlike previous findings, that women are more paranoid than men.⁸ In fact, both genders were equal in their scores of psychopathic deviances, and this finding differs from that in previous studies.⁹

Polysubstance users had more serious problems in the paranoia and hypomania scales irrespective of gender differences. The values of the paranoia scale were extremely high in the polysubstance group. Moreover, the values of the hypomania scale correlated with polysubstance use, diminishing with higher education levels. Notably, subjects with higher education levels had moderately higher scores compared with the overall average.

Findings from the present study revealed that men have more serious problems regulating emotions, although women also had moderately high values in most scales. Both groups produced higher than normal values on the depression, psychopathic deviate, paranoia, anxiety, thinking disturbances, and hypomania scales. Their profiles were interpreted as indicating increased tendencies toward acting-out behavior, high levels of stress and psychological discomfort, interpersonal guardedness, and hostility. Both genders had difficulties regulating their emotions and behaviors, although men found it more difficult to do so.

The personality factors in this study appeared independent of education level except the hypomania scale. The values of the hypomania scale diminished with higher education levels. Subjects with higher education levels had moderately higher values compared with the average level. Patients tended to be bored and

restless easily. Moreover, their frustration tolerance was low, suggesting that both genders have features of hyperactivity and short attention span.

The personality factors also appeared independent of onset age of regular substance use, except the masculinity-femininity scale. Participant groups with early onset of regular substance use had both lower and higher values, which tended to diminish with later onset age. The results suggest that deviance from traditional masculinity and femininity interests may be a risk factor for substance abuse.

The present study demonstrated qualitative differences in emotion regulation between male and female substance-dependent individuals. However, knowledge of gender differences in emotional brain development is still limited. Emotional and personality disturbances associated with substance use are suggested to be based on earlier proneness to negative emotionality and social deviance in men and women.^{7,17,18}

Regarding treatment, prognosis is unfavorable for both men and women because of their lack of insight into and resistance to the psychological components of their condition. As such, it may be useful to combine self-report inventory tests with more advanced methods for personality research, for example, the schema-focused approach¹⁸ and the Rorschach Comprehensive System.¹⁷ These methods can help patients to recognize persistent, maladaptive patterns of thinking, feeling, and behaving. It is also important to openly discuss and evaluate affect dysregulation and impulse control problems targeting relapse of substance use. Although personality disorders are said to explain only a small proportion of the use of intoxicants, it is essential to identify related disturbances in regulating feelings and behaviors during treatment. Moreover, our findings of personality and emotional variables enable to develop cost-effective screening procedures for clinical use in SUDs.

Limitations and Advantages

One limitation of this study is that we were unable to investigate the effects of specific substances, as nearly half of the participants abused multiple substances. Each substance of abuse presents

with a diverse pattern of cognitive deficits. It is impossible to recruit matched control groups, which is a fundamental shortcoming of observational research that cannot be solved by merely adding covariates to the analysis.¹⁹ We expected that our study sample would be more realistic than those in studies that tracked the effects of various drugs with specified amounts. The different substance use groups were not analyzed separately, mainly to avoid type II error in multiple testing. The data collection method was naturalistic and observational. As noted in the multiway analysis of covariance, the significance of polysubstance use in this study was generally negligible. The results suggest that using only one substance, mostly alcohol, is sufficient to impair performance level.

Another weakness is that our sample size was moderate. The number of patients in the neuropsychological tests varied, being smaller in memory and learning tasks. Patients' effort to complete time-consuming neuropsychological tests also varied.

Moreover, the new MMPI-2 version has not been translated and standardized in Finnish, so we used the primary MMPI.¹⁵ The MMPI-2 is similar in many ways to the original MMPI. Much of the research concerning the interpretation of the original MMPI still applies directly to the MMPI-2. We also used the interpretation of Graham,¹⁸ as it includes further discussion of similarities and differences between the original MMPI and the MMPI-2. We also used the old version of WAIS (WAIS-R) in the assessment of intellectual capacity since the study started in 2004 when WAIS-III was not yet translated and standardized for use by psychologists in Finland. Likewise, WMS-R was used as a memory test because the new WMS-III came into use in Finland only in 2008. To ensure consistency, the tests were based on WAIS-R and WMS-R.

A major strength of this study is the carefully diagnosed hospital participants. They were diagnosed by psychiatrists specialized in substance abuse disorder and mood disorder using ICD-10 criteria for the diagnosis of each condition. The duration of abstinence was stated in laboratory tests.

REFERENCES

1. Fattore L, Melis M. Sex differences in impulsive and compulsive behaviors: a focus on drug addiction. *Addict Biol.* 2016;21:1043–1051.
2. van der Plas AAE, Crone EA, van den Wildenberg W, et al. Executive control deficits in substance-dependent individuals: a comparison of alcohol, cocaine, and methamphetamine and of men and women. *J Clin Exp Neuropsychol.* 2009;31:706–719.
3. Flannery B, Fishbein D, Krupitsky E, et al. Gender differences in neurocognitive functioning among alcohol-dependent Russian patients. *Alcohol Clin Exp Res.* 2007;31:745–754.
4. Liu I, Chiu C, Yang T. The effects of gender and a co-occurring depressive disorder on neurocognitive functioning in patients with alcohol dependence. *Alcohol Alcohol.* 2010;45:231–236.
5. Green A. The effect of moderate to heavy alcohol consumption on neuropsychological performance as measured by the repeatable battery for the assessment of neuropsychological status. *Alcoholism.* 2010;34:443–450.
6. Alarcon R, Nalpas B, Pelletier S, et al. MoCA as a screening tool of neuropsychological deficits in alcohol-dependent patients. *Alcohol Clin Exp Res.* 2015;39:1042–1048.
7. Mulder R. Alcoholism and personality. *Aust N Z J Psychiatry.* 2002;36:44–52.
8. Graham JR. *MMPI-2: Assessing Personality and Psychopathology.* New York: Oxford University Press; 1993.
9. Mellos E, Liappas I, Paparrigopoulos T. Comorbidity of personality disorders with alcohol abuse. *In Vivo.* 2010;24:761–769.
10. Kessler RC. Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence with other psychiatric disorders in the National Comorbidity Survey. *Arch Gen Psychiatry.* 1997;54:313–321.
11. Portin R, Kovala T, Polo-Kantola P, et al. Does P3 reflect attentional or memory performances, or cognition more generally? *Scand J Psychol.* 2000;41:31–40.
12. Revonsuo A. Words interact with colors in a globally aphasic patient: evidence from a Stroop-Like Task. *Cortex.* 1995;31:377–386.
13. Lilja AM, Portin RI, Hämäläinen PI, et al. Short-term effects of radiotherapy on attention and memory performances in patients with brain tumors. *Cancer.* 2001;91:2361–2368.
14. Portin R. Cognitive functioning in midlife. *Psykologia.* 2001;36:239.
15. Welsh GS, Dalstrom WG. *Basic Readings on the MMPI (=Minnesota Multiphasic Personality Inventory) in Psychology and Medicine.* Minneapolis, MN: University of Minnesota Press; 1956.
16. Tuchman E. Women and addiction: the importance of gender issues in substance abuse research. *J Addict Dis.* 2010;29:127–138.
17. Bergman I, Haver B, Bergman H, et al. Personality characteristics of women with alcohol addiction: a Rorschach study of women in an early treatment programme. *Scand J Psychol.* 1998;39:47–54.
18. Shorey RC, Stuart GL, Anderson S, et al. Do gender differences in depression remain after controlling for early maladaptive schemas? An examination in a sample of opioid dependent treatment seeking adults. *Clin Psychol Psychother.* 2012;20:401–410.
19. Schulte MHJ, Cousijn J, den Uyl TE, et al. Recovery of neurocognitive functions following sustained abstinence after substance dependence and implications for treatment. *Clin Psychol Rev.* 2014;34:531–550.