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Original article

Change in personality over time according to the Drug-of-Choice: a longitudinal study in a community-based treatment program for drug abusers

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Abstract

***Introduction*: The relation between personality disorders (PD) and substance-use disorders (SUD) is a topic of growing interest. Comorbidity of PDs with SUDs has important clinical implication in term of treatment, such as resistance and premature discontinuation of rehabilitation programs. Very limited data are available on change in specific personality dimensions over time depending on the Drug of Abuse.**
***Aim of the study*: The aim of the present study is to investigate changes over time in personality dimensions in a community-based treatment program for drug abusers according to the Drug-of-Choice.**
***Methods*: This is a 1-year follow-up observational study. Patients from a rehabilitation community in Sardinia, Italy, were consecutively recruited. Millon-Clinical-Multiaxial-Inventory-III (MCMI-III) was performed at baseline (the entry at the therapeutic community treatment) and at 1 year of follow-up. Patients were stratified according to the Drug-of-Choice in 4 groups: Cocaine, Heroin, Alcohol and Cannabis abusers. Paired T-Student test was applied for quantitative variables in T0 and T1, with significant level at 0.05.**
***Results*: A total of 147 patients was assessed at baseline, with 55 drop-outs (38.7%) before 1 year of treatment. The final sample consisted in 87 patients, 76 men (87.4%) and 11 women (12.6%). Mean age of the participants was 36 years (sd = 9.1 years) with mean age at onset of substance abuse of 20.3 (sd = 7.7). In the final sample the 4 groups according to the Drug-of-Choice were: 20 (23%) for cocaine, 31 (35.6%) for heroine, 26 (29.9%) for alcohol and 10 (11.5%) for cannabis. *Cocaine* addicts showed significant reduction over time in Antisocial (p=0.030) and increase in Obsessive-Compulsive (p=0.001) personality disorders scores. *Heroin* addicts showed a significant reduction in Schizoid (p=0.006), Avoidant (p=0.001), Depressive (p=0.004), Antisocial (p=0.050), Negativistic (p=0.016), Masochistic (p=0.047), Borderline (p=0.008), Paranoid (p=0.045) scores. A statistical increase in Histrionic (p=0.034) and Obsessive-Compulsive (p=0.027) personality scores was detected at follow-up. *Alcohol* addicts showed a reduction in Schizoid (p<0.001), Avoidant (p=0.001), Depressive (p=0.001), Dependent (p=0.034), Negativistic (p=0.002), Paranoid (p=0.011) and Schizotypal (p 0.002) personality scores. Also in alcohol group a significant increase in Histrionic (p=0.010) and Compulsive (p=0.029) personality scores was observed. *Cannabis* addicts showed a significant reduction in Schizoid (p=0.024) and Dependent (p=0.019) personality scores.**
***Conclusions*: These results show how personality changes in drug abusers significantly differ depending on the drug-of-choice. Narcissistic PD did not change over time both for the total sample and in any group. Cocaine and Cannabis addicts appear the most treatment-resistant groups across different personality dimensions, while Heroine and Alcohol addicts showed changes in the majority of PD.**

KEY WORDS: drug-of-choice, substance-related disorders, community-based treatment program, personality.

Introduction

Personality is a controversial construct, and numerous researches have attempted to define and refine

this concept. Traditionally, personality traits are defined as persistent patterns of perceiving, relating to, and thinking about the environment and oneself that are manifested in various social and personal contexts. These characteristics can comprise conditions in which they are inflexible and maladaptive, and resistant to change, causing significant functional impairment or persistent subjective distress (1). However, despite the fact that personality disorders are described as persistent disorders, some studies show that these diagnoses can change over time (2, 3). Epidemiological studies have shown that personality pathological traits are at them most marked in the late 10s and early 20s, and follow-up studies suggest improvement in most areas of personality function after 2 years (4). The prevalence of personality disorders (PD) in substance use disorder (SUD) populations is approximately 4 times higher than that in the general population (5). Substance use disorder is considered a chronic and recidivant disorder (Sher 2006) and the relation between both disorders is a topic of growing interest in light of evidence that this population have worse prognosis, is more resistant to change and often discontinue treatment prematurely. Empirical studies have showed high rates of co-occurrence between SUDs (alcoholism and substances) and PDs, with reported rates ranging from 30 to 75% (5-8) and with a high frequency of cluster B PDs (especially antisocial and borderline personality disorder) (9-11), as well as narcissistic and histrionic personality disorders (12,13).

Even if it is generally agreed that individuals with SUD as a whole differ from controls on several broadly defined personality dimensions, nevertheless it is unclear to which degree of specificity these traits may be differentially linked to particular classes of substances. A few papers reported different personality profiles between specific drug users. Conway et al. (2001) investigated the association between substance abuse/dependence, drug-of-choice and the personality traits of negative emotionality, positive emotionality, and constraint (disinhibition) finding a difference in terms of constraint according to drug-of-choice (opioid, cocaine or stimulants, marijuana or sedatives, or alcohol). Some post-hoc analyses showed that personality profiles were linked to some preferential choice of drug: heroin patients scored higher in Novelty-Seeking and Self-Directedness than alcohol patients, Exploratory Excitability segregated up to 76% of heroin patients from alcohol patients (14). On the contrary, a recent review analyzed studies on two of the most commonly investigated decision-making processes, delay discounting and risk taking, in substance abusers as a function of drug-of-choice (15), suggesting that these two facets of decision-making were similar across drugs of abuse.

Even less studies have measured change in PDs during treatment programs. Longitudinal studies showed significant changes on almost all the PD scales of the MCMI after 1 month of treatment (16, 17) and in the long-term (18). The same results were found in a more recent study that explored the changes of personality dimensions by the MCMI-III in a therapeutic community (3-months study) in a large sample of drug abusers (cocaine-dependent patients) (19). A long-term study, on the contrary, demonstrated significant changes in the dimensional scores of some personality disorders (schizoid, avoidant, dependent, passive-aggressive, schizotypal and borderline), whereas other dimensional scores did not change at all over a period of 6 years in drug abuse patients in a therapeutic community (20).

The relation between changes in personality traits over time in SUD patients is a crucial topic of clinical and research interest. To our knowledge, up to date no study has analyzed changes during long-term treatment in personality dimensions according to the drug-of-choice in a community sample of drug abusers. The aim of the present study is to investigate changes over time in personality dimensions in a community-based long-term treatment program for drug abusers according to the Drug-of-Choice.

Methods

Study design

The study design was observational, analytical and prospective (1-year follow-up). Assessment was performed at T0 (at the start of therapeutic community treatment) and at 1 year of follow-up (T1). After the clinical staff screened the potential participants for eligibility, the selected candidates were informed of the aims of the study and asked to sign an informed consent form if they consented to participation. The selected participants were assessed by one psychiatrist and one psychologist. Participants were assessed individually in a dedicated room inside the therapeutic community and were not compensated for their participation in the study.

Participants selection

The target population consisted of individuals with a diagnosis of substance or alcohol related disorder (dependence), following DSM-5 criteria, consecutively recruited between June 2008 and April 2016 from a rehabilitation community in Sardinia, Italy. Patients were stratified according to the Drug-of-Choice in 4 groups: Cocaine, Heroin, Alcohol and Cannabis abusers. Drug-of-Choice was defined as: self-reported drug-of-choice (the drug they would prefer to use if it were available), the predominant drug of abuse/dependence was determined by a final 'best estimate' diagnosis based on all available information, including the diagnostic interview, treatment and medical records, history reports of quantity, frequency, chronicity, number of symptoms, and severity. Because the predominant drug of abuse/dependence reflects a particular drug-use disorder, subjects with polysubstance abuse/dependence were classified into the drug group representing the most predominant pattern of abuse and related impairment. The main

inclusion criteria to enter the study included: fulfilling the DSM-5 criteria for substance/alcohol disorder; at least 18 years of age; the ability to read and write, and the completion of an informed consent form. The exclusion criteria included an organic cognitive impairment that impeded psychopathological exploration. All patients remained abstinent while in therapeutic community.

Clinical assessment and instruments

The clinical and psychopathological characteristics, as well as the anamnestic information have been collected through structured and semi-structured clinical interviews and through the visualization of the previous medical documentation.

The Millon-Clinical-Multiaxial-Inventory-III (MCMI-III) was performed at baseline (at the start of therapeutic community treatment) and at 1 year of follow-up. The MCMI-III (Millon & Davies, 1997), is a self-administered questionnaire that evaluates the presence of clinical symptoms of certain personality patterns and the probability that such patterns constitute a personality disorder. The MCMI-III scales are grouped into personality and psychopathology categories to reflect the distinction that the DSM makes between Axis I and Axis II. The scale consists of 175 dichotomous (true or false) response items. A base rate score greater than 75 indicates the likelihood of a personality disorder, and a base rate greater than 85 indicates the severity of the disorder. Test time ranges from 20 to 30 minutes.

Statistical analyses

Descriptive statistics were used to explore the sample characteristics. Univariate comparisons of demographic and clinical characteristics were performed using Pearson Chi-square and Fisher's exact test in contingency tables ($\chi 2$), when appropriated for categorical (α value, two tailed) analyses and t tests (for quantitative variables with a normal distribution). Multivariate analyses were applied when the sample was stratified in 4 groups according to the DOC. Data were analyzed with analyses of variance ANOVA (Tuckey correction) for continuous variables in order to detect statistically significant differences between MCMI-III scores. Paired T-Student test was applied for quantitative variables in T0 and T1, with significant level at 0.05 to compare rating scales scores in baseline and follow-up in order to detect a significant changes over time in MCMI-III scores. Analyses were performed using the Statistical Package for Social Sciences (SPSS, 18.0 version for Windows; IBM Corporation, Armonk, NY, USA).

The rehabilitation program

The rehabilitation program of the "Mondo X Sardegna" community is not based on a structured univocal model of reference, and is articulated in specific phases: Evaluation (of the actual motivation to participate in the community program), Bond with the Community (a separation from the external environment is foreseen); Autonomy (greater responsibility within the group); Social reintegration. The main reasons for referral are (a) an inability to maintain abstinence during outpatient treatment and (b) the clinicians' or patients' perception of required continuous and intensive treatment. Admissions to therapeutic communities are always voluntary. All patients remained abstinent while in therapeutic community and at the time of the interviews. One of the objectives of treatment is to instill changes in thinking and behaviour, most specifically to have patients change their attitude toward various aspects of life's challenges. The residential treatment is highly confrontational and group-oriented in order to modify chronic, disruptive behavior patterns. The clinical staff is a mixture of degreed and non-degreed professionals; a substantial number of the staff consists of ex-substance abusers. Services provided in addition to physical exercise and structured group activities include social skills training, educational and daily activity in countryside (agriculture and animal husbandry).

Results

Socio-demographic and clinical variables in the total sample

A total of 147 patients was assessed at baseline, with 55 drop-outs (38.7%) before 1 year of treatment. No statistical differences were detected in socio-demographic and clinical characteristics between patients according to 1-year drop-out. The final sample consisted in 87 patients, 76 men (87.4%) and 11 women (12.6%). Mean age of the participants was 36 years (sd = 9.1 years) with mean age at onset of substance abuse of 20.3 (sd = 7.7) (Table 1a). In the final sample the 4 groups according to the drug-of-choice were: 20 (23%) for cocaine, 31 (35.6%) for heroine, 26 (29.9%) for alcohol and 10 (11.5%) for cannabis (Table 1b). No statistical differences were detected in 1-year drop-out depending of the Drug-of-Choice. Gender were equally distributed between Drug-of-Choice groups (Table 1b). Rates of drop-out after 1 year of community treatment were higher in Cannabis group (83.9%) compared to other groups and all individuals of this group have polyabuse (100%). It was frequent also in cocaine group (90%) and in Heroine group (86.5%), while less frequent in alcohol group (34.6%). Lifetime dual diagnosis was also frequent: 75% for Cocaine, 77.4% for Heroine, 73.1% for Alcohol and 80% for Cannabis abusers. Current Axis I diagnosis was current in 20% of Cocaine, 32.3% of Heroine, 38.5% for alcohol and 40% for Cannabis abusers. Pharmacological treatment was present in 45% of Cocaine, 67.7% of Heroine, 57.7% of Alcohol and in 40% of Cannabis abusers. Personality disorders (according to MCMI-III cut-off of 85) were prevalent in 56.3% of total sample: 62.1% in Cocaine abusers, 51.1% in Heroine, 56.8% in Alcohol abusers and 60% in Cannabis group. The most prevalent Personality Disorder was Antisocial in three groups: co-

caine (n=7; 36.7%), Heroine (n=7; 26.9%) and Cannabis (n=4, 40%), while in Alcohol group the most prevalent Personality Disorder was Dependent (n=8; 30.8%) (Table 1b).

Mean scores of MCMI-III at the Baseline and Follow-Up Interview in the total sample and according to the Drug-of-Choice

Table 2 shows the mean scores of MCMI-III at the baseline and follow-up interview in patients who completed 1-year follow-up (n=87). All personality disorders but two (Narcissistic and Sadistic) showed a statistically significant clinical improvement at follow-up compared to baseline measurement (follow-up mean scores were significantly lower at T1). Histrionic ($p=0.003$) and Obsessive-compulsive ($p<0.001$) personality disorder showed significant higher mean scores at follow-up in the total sample. Multivariate analyses were applied to MCMI-III mean scores both in T0 and T1 according to drug-of-choice in order to detect statistically significant differences between groups (Table 3). Few statistically significant differences were detected. At baseline evaluation, Histrionic PD was significantly higher in Cocaine group compared to Alcohol group and Antisocial score was significantly higher in Cannabis group compared to Alcohol, while at follow-up Obsessive-compulsive PD was significantly higher in Alcohol group compared to Cannabis.

Comparison of MCMI-III Scores changes over time between the Baseline and Follow-Up according to the drug-of-choice

A Paired T-test was applied to each group in order to assess changes in MCMI-III mean scores over time, after 1 year of community treatment. Cocaine addicts

Table 1a. Descriptives.

Variables	Total (87)		Variables	Total(87)	
	mean/N	+-SD/%		Mean/N	+-SD/%
Sociodemographics			Double Diagnosis	66	75,9%
Males	76	87,4%	Comorbid Axis I	28	32,2%
Year of birth	1974,09	9,137	DDM	14	16,1%
Age	35,99	9,137	Schizoaffective	1	1,1%
N° offspring	0,62	1,003	Bipolar type I	1	1,1%
N° secondary drug	1,74	1,667	Bipolar type 2	5	5,7%
Age substance abuse onset	20,24	7,663	GAD	4	4,6%
			Impulses dysregulation	2	2,3%
N°imprisonments	0,63	1,182	Stress reaction disorder	1	1,1%
N°Crimes committed	0,63	,878	OCD	0	0%
N°Axis II Personality Disorders	1,09	1,041	Insomnia	0	0%
N°hospital admissions	0,18	,601	Comorbid Axis II		
N°suicide attempt Lifetime	,041	1,427	Schizotypical	3	3,4%
Age 1st suicide attempt	30,57	8,336	Schizoid	4	4,6%
Marital Status			Paranoid	4	4,6%
Married	8	9,2%	Borderline	11	12,6%
Separated	12	13,8%	Hystrionic	1	1,1%
Divorcied	5	5,7%	Narcisistic	15	17,2%
Single	61	70,1%	Antisocial	26	29,9%
Widow	1	1,1%	Dependent	20	23,0%
Drug of choice			OCD	2	2,3%
Cocaine	20	23%	Avoidant	9	10,3%
Heroine	31	35,6%	Farm. Treatment	49	56,3%
Alcohol	26	29,9%	Hospitalized	11	12,6%
Cannabis	10	11,5%	Detentions	32	36,8%
Polyabusers	62	71,3%	Committed Crimes	35	40,2%

Table 1b. Descriptives within Drug Of Choice.

Variables	Cocaine (n=20)		Heroine (n=31)		Alcohol (n=26)		Cannabis (n=10)	
	m/N	+-SD/%	m/N	+-SD/%	m/N	+-SD/%	m/N	+-SD/%
Sociodemographics								
Age	3,40	8,529	34,45	7,978	41,38	9,295	30,1	7,4
Age substance abuse onset	17,95	5,951	20,42	5,143	23,96	10,558	14,60	1,174
N°hospital admissions	0,2	0,894	0,06	0,250	0,38	0,697	0	0
Males	19	95%	23	80,6%	22	84,6%	10	100%
Polyabusers	18	90%	25	80,6%	9	34,6%	10	100%
Double diagnosis	15	75%	24	77,4%	19	73,1%	8	80%
Comorbid Asse I	4	20%	10	32,3%	10	38,5%	4	40%
Schizoaffective	1	5%	0	0%	0	0%	0	0%
Bipolar Disorder	1	5%	1	3,2%	2	7,7%	0	0
General Anxiety Disorder	0	0	2	6,5%	1	3,8%	1	10%
Impulse dysregulation	0	0	1	3,2%	1	3,8%	0	0
Stress reaction disorder	0	0	0	0	1	3,8%	0	0
OCD	0	0	0	0	0	0	0	0
Farm Treatment	9	45%	21	6,7%	15	57,7%	4	40%
Comorbid Axis II*								
Schizoid	0	0	1	3,2%	3	11,5%	0	0
Avoidant	1	5,3%	4	12,9%	4	15,4%	0	0
Dependent	1	5,3%	3	9,7%	8	30,8%	1	10%
Histrionic	0	0	1	3,2%	0	0	0	0
Narcissistic	3	15,8%	4	12,9%	3	11,5%	1	10%
Antisocial	7	36,8%	9	29%	7	26,9%	4	40%
OCD	0	0	2	6,5%	0	0	0	0
Borderline	1	5,3%	2	6,5%	5	19,2%	2	20%
Paranoid	0	0	1	3,2%	2	7,7%	1	10%
Schizotypal	0	0	2	3,2%	1	3,8%	1	10%

*total sample is 86

showed significant reduction over time in Antisocial (p=0.030) and increase in Obsessive-Compulsive (p=0.001) personality traits. Heroin addicts showed a significant reduction in Schizoid (p=0.006), Avoidant (p=0.001), Depressive (p=0.004), Antisocial (p=0.050), Negativistic (p=0.016), Masochistic (p=0.047), Borderline (p=0.008), Paranoid (p=0.045) scores. A statistical increase in Histrionic (p=0.034) and Obsessive-Compulsive (p=0.027) personality scores was detected at follow-up. They presented also with significant reductions in mean scores of psychopathological dimensions: alcohol dependence, dysthymia, bipolar disorder and major depression. Alcohol addicts showed a reduction in Schizoid (p<0.001), Avoidant (p=0.001), Depressive (p=0.001), Dependent (p=0.034), Negativistic (p=0.002), Paranoid (p=0.011) and Schizotypal (p 0.002) personality scores, as well as alcohol dependence (p=0.002), dysthymia (p=0.006), thought disorder (p=0.007) and major depression (p=0.006). Also in alcohol group a significant increase in Histrionic (p=0.010) and Compulsive (p=0.029) personality was observed. Cannabis addicts showed a significant reduction in Schizoid (p=0.024) and Dependent (p=0.019) personality scores, alcohol dependence (p=0.022) and delusional disorder (p=0.006). Multivariate analyses were applied to MCMI-III mean scores both in T0 and T1 according to Drug-of-Choice in order to detect statistically significant differences between groups. Few statistically significant differences were detected. At

Table 2. Scores Million T0→T1 total sample.

Variables	Mean T0	Sd	Mean T1	Sd	T	p
Axis II						
Schizotypal	52,78	26,325	42,88	26,211	3,933	,000
Paranoid	54,22	25,814	42,03	28,680	4,503	,000
Schizoid	61,21	19,065	50,08	24,658	4,400	,000
Avoidant	55,32	29,766	42,08	31,879	4,308	,000
Depressive	68,25	27,407	55,57	29,584	4,532	,000
Dependent	55,63	28,479	47,69	30,389	3,556	,001
Histrionic	49,08	17,559	54,61	14,460	-3,100	,003
Narcissistic	62,36	17,395	61,06	14,576	,710	,480
Borderline	58,50	24,356	48,32	23,696	3,663	,000
Antisocial	73,03	17,113	66,71	18,909	3,494	,001
Sadistic	64,24	15,833	61,64	19,512	1,529	,131
Compulsive	44,69	12,155	50,00	12,166	-4,365	,000
Negativistic	63,96	25,746	50,88	27,480	5,055	,000
Masochistic	56,49	30,025	47,75	31,163	2,749	,008
Cluster A	55,78	19,808	44,88	21,853	6,108	,000
Cluster B	60,49	11,261	57,43	10,952	2,471	,016
Cluster C	54,79	18,147	47,15	18,063	4,715	,000
Axs I						
Alcohol dependence	72,76	17,745	62,49	20,505	4,465	,000
Anxiety	59,13	31,352	48,63	31,881	2,977	,004
Dysthymia	57,15	29,948	41,65	30,498	4,083	,000
Somatizations	39,76	28,629	29,33	27,600	2,567	,012
Bipolar	59,14	15,766	50,03	21,554	4,157	,000
Drug dependence	80,94	16,659	78,22	19,569	1,727	,089
Self Devaluation	56,07	19,728	46,39	19,940	3,997	,000
Psychosis	57,07	27,914	41,21	27,302	5,218	,000
DDM	43,11	29,300	28,90	26,312	3,716	,000
Delusional Disorder	47,60	26,838	37,88	27,867	2,702	,009

baseline evaluation, Histrionic PD was significantly higher in Cocaine group compared to Alcohol group and Antisocial score was significantly higher in Cannabis group compared to Alcohol, while at follow-up Obsessive-compulsive PD was significantly higher in alcohol group compared to Cannabis.

Discussion

The aim of the present study was to investigate changes over time in personality dimensions in a community-based rehabilitation long-term program for drug abusers and to analyze if the potential changes were associated with different Drug-of-Choice (Cocaine, Heroin, Alcohol and Cannabis). To our knowledge this is the first study that investigated personality disorder in drug abusers according to drug-of-choice in the long term treatment in a community program.

First, it is noteworthy that our drop-out is quite high (39%), and this can be a limitation of the study. Further analyses must be performed by taking in consideration the initial sample, including drop-out patients.

Table 3. Millon changes from T0 to T1 within DOC variables.

Variables	Cocaine		Heroin		Alcohol		Cannabis	
	t	p	t	p	t	p	t	p
Schizoid	0,215	0,832	0,215	0,832	4,880	0,000	4,880	0,000
Avoidant	-0,023	0,982	-0,023	0,982	3,829	0,001	3,829	0,001
Depressive	1,067	0,302	1,067	0,302	3,860	0,001	3,860	0,001
Dependent	1,153	0,266	1,153	0,266	2,281	0,034	2,281	0,034
Histrionic	0,206	0,839	0,206	0,839	-2,844	0,010	-2,844	0,010
Narcissistic	2,035	0,059	2,035	0,059	0,064	0,950	0,064	0,950
Antisocial	2,384	0,030	2,384	0,030	0,863	0,399	0,863	0,399
Sadistic	0,787	0,443	0,787	0,443	1,011	0,325	1,011	0,325
Compulsive	-3,949	0,001	-3,949	0,001	-2,366	0,029	-2,366	0,029
Negativistic	1,871	0,080	1,871	0,080	3,699	0,002	3,699	0,002
Masochistic	0,821	0,424	0,821	0,424	1,461	0,160	1,461	0,160
Alcohol Dependence	1,232	0,236	1,232	0,236	3,642	0,002	3,642	0,002
Anxiety	0,383	0,706	0,383	0,706	2,041	0,055	2,041	0,055
Borderline	0,988	0,338	0,988	0,338	1,694	0,107	1,694	0,107
Dysthymia	1,063	0,304	1,063	0,304	3,122	0,006	3,122	0,006
Somatization	0,929	0,367	0,929	0,367	1,465	0,159	1,465	0,159
Bipolar	2,376	0,030	2,376	0,030	1,750	0,096	1,750	0,096
Paranoid	1,843	0,084	1,843	0,084	2,834	0,011	2,834	0,011
Schizotypal	0,996	0,334	0,996	0,334	3,550	0,002	3,550	0,002
Drug Dependence	1,127	0,276	1,127	0,276	0,850	0,406	0,850	0,406
Self Devaluation	0,813	0,428	0,813	0,428	3,333	0,003	3,333	0,003
ClusterA	1,348	0,196	1,348	0,196	6,129	0,000	6,129	0,000
Cluster B	2,025	0,060	2,025	0,060	0,659	0,518	0,659	0,518
Cluster C	0,852	0,407	0,852	0,407	4,156	0,001	4,156	0,001
Psychosis	2,701	0,016	2,701	0,016	3,010	0,007	3,010	0,007
DDM	1,158	0,264	1,158	0,264	3,076	0,006	3,076	0,006
Delusional Disorder	0,298	0,769	0,298	0,769	1,106	0,283	1,106	0,283

The two samples, anyway, did not differ on socio-demographic characteristics. Our study showed that after 1 year of community-based rehabilitation treatment, almost all personality dimensions changes in the total sample toward a clinical improvement of almost all personality dimensions. This is consistent with the results of other studies that have examined changes in personality pathology in drug abuse patients during treatment, by means of the previous version of MCMI (17, 18, 21, 22). In our sample all personality disorders but Narcissistic showed a statistically significant clinical improvement at follow-up compared to baseline measurement. According to our results, a previous study failed to find long-term changes in a number of personality dimensions, including narcissistic PD (20). This result can be interpreted in light of two factors: the first is that at the entry in the treatment program, the mean scores of Narcissistic PD were not pathological, so it may be plausible that they have not changed over time. The second reason may be related to the very nature of rehabilitation program, where the objectives are oriented to face other disruptive behavior patterns. Drug abuse patients with Narcissistic PDs tend to be self-oriented and resist pressure for the attitude and behavior changes that therapeutic communities wish to instill. Histrionic and Obsessive-compulsive personality disorder showed significant higher mean scores at

follow-up in the total sample. The significant increase in Obsessive-Compulsive scores may be explained by the fact that three of the eight MCMI-III items for obsessive compulsive disorder refer to compliance with the rules and responsible conduct of their work: "I take the rules into consideration because they are a good guide to follow "(item 2)," I always make sure that my work is well planned and organized "(item 82)," I always worry about finishing my work before devoting myself to leisure "(item 172). Work and respect for the rules are two of the six cornerstones of the therapeutic method of the "Mondo X Sardegna" community. The same is plausible for the higher scores in Histrionic PD at follow-up. These characteristics are evaluated by 3 of the 7 items that quantify MCMI-III Histrionic score: "I demonstrate my feelings easily and promptly" (item 12), "I always try to make new friends and meet new people" (item 32), " I think I am a sociable and outgoing person "(item 57). Treatment in the therapeutic community seeks to start a socialization process in which the self-concept is addressed, and self-esteem is improved, to help patients learn to cope with problems in new ways and changes are in the direction of better communication, more contact with other people and less solitary activities.

What is new in our study is that specific changes in personality occur according to the drug-of-choice. It is particularly noteworthy that first evaluation with multivariate analyses, there were only two significant differences in personality scores between the four groups of Drug-of-Choice: Histrionic PD score was significantly higher in the Cocaine group compared to Alcohol group and Antisocial PD score was significantly higher in the Cannabis group compared to Alcohol dependent patients.

After 1-year of treatment program, Cocaine addicts showed to be the most resistant group, with significant reduction over time in the only Antisocial personality disorder. Obsessive traits were also significantly higher, reflecting the general trend of the sample. This can be interpreted in light of the fact that at T0 the mean scores at Narcissistic PD were higher in the Cocaine group compared to other the groups (a trend, not significant), probably identifying a style of personality less inclined to accept criticism and then to make real changes in the emotional and personal lifestyle.

Heroin addicts a general improvement in most of the PD traits: significant reductions in cluster A (Paranoid Schizoid), cluster B (Antisocial, Borderline), cluster C (Avoidant, Depressive). A statistical increase in Histrionic and Obsessive-Compulsive personality scores was detected at follow-up. The hypothesis that we can formulate with respect to the good responsiveness of heroin addicts to the community treatment may be linked to the tendency observed in this group to have average scores for individual personality styles generally lower than the other groups. Antisocial PD is excluded, being high also in this group, and this is in line with literature, which identifies it as the disorder most frequently associated with the use of heroin (23).

Alcohol addicts showed a reduction in all PDs of Cluster A (Paranoid, Schizoid and Schizotypal) and cluster C (Avoidant, Depressive, Dependent) and a significant increase in Histrionic and Compulsive personality traits. Contrary Cocaine and Heroine groups, in Alcohol abusers Antisocial did not show any statistical change over time. It can be expected since alcohol is a legal drug, while the persons using the illegal drugs can be suspected to be more prone to ignore laws and rules presenting with a more antisocial profile at the beginning of the treatment. Community rules and rehabilitation program may have been more useful for such a sample whose behavioral problems were related to an antisocial profile. Also, as alcohol is more often used to reduce stress, alcoholics can also be hypothesized to have more "negative emotional" personalities, that is, to be more avoidant of danger and dependent than other substance users and may profit from the structure, protection, and support which the therapeutic community provides.

Cannabis addicts showed a significant reduction in Schizoid and Dependent personality scores. This result can be read in light of the fact that Cannabis users in our sample presented with the highest average number of secondary drugs associated with the drug-of-choice (higher frequency of poly-abuse), a negative prognostic factor associated with a higher risk of drop-out in residential treatments (24).

Consistent with prior research (25) our findings suggest that personality traits are unstable over long period. Considering that personality is a multifactorial construct, we can speculate that some personality attributes remain the same, but what is manifest clinically depends on the circumstances. In assessing personality it might therefore be more adequate to record personality disorder as personality function at first, retaining the notion of core personality features, and to consider long-term changes in response to lifestyle changes and those in personal and social circumstances. The present study further advances prior research by demonstrating that the notion of a persistent and pervasive abnormality that perseveres no matter what happens in life is no longer an acceptable way to view personality disorder. The observed link between changes in specific personality traits and drug selection can also be interpreted in terms of current knowledge that pre-existing neurobiological characteristics may lead to abuse of a particular drug (26). In light of compelling data and theory suggesting that the origins of personality precede the development of substance-use problems, one interpretation of the association between specific PD and drug choice is that personality traits serve as pre-existing factors that guide individuals' choice of substances. In particular, increased activity of the behavior activation system (via increased dopaminergic transmission) and decreased activity of the behavior inhibition system (via decreased serotonergic transmission) has been associated with greater novelty seeking, im-

pulsivity, and drug-seeking behavior (27). The action of drugs including heroin and cocaine appears to facilitate dopamine transmission in mesocorticolimbic circuits, which are believed to be central to the rewarding effects of drugs (27, 28). Alcoholics demonstrate greater negative emotionality and impulsivity than do non-alcoholics and these traits often precede the onset of alcohol-related problems (29). On the other hand, considering that chronic substance abuse may induce psychiatric states that modify the assessment of personality and altering neurotransmitter system (30), further studies that identify the temporal dynamics of the personality-substance abuse link will be especially informative. Future studies with a randomized design are needed to validate the present results.

Changes during treatment in personality disorder are difficult to interpret. It would be inadequate to definitively confirm or reject the hypothesis of an absence of stability of personality patterns over time. Anyway, our results show that certain personality behaviors of abstinent patients improve during treatment, and are different according to the specific drug-of-choice. This is consistent with some previous studies that found improvement of dimensional scores of some PD (16-20, 22, 31). For instance, the fact that Narcissistic PD is mostly reported in cocaine users can be interpreted on the basis that the typical traits of this disorder may be emphasized and somehow potentiated by the use of cocaine, able to function as a possible amplifier. Anyway, explication of this etiological association is not possible based on the mere design of the present paper, and longitudinal studies are needed in order to study temporal association of clinical symptoms and substance abuse onset.

Comparison with previous studies of results for changes in PD for different Drug-of-Choice is limited due to the lack of previous literature with similar methodological design. These findings should, however, be evaluated in light of several study limitations. Limitations to the generalization of these results include relatively small groups for multivariate comparisons and subgroups of insufficient size to study the possibly confounding factors (psychiatric comorbidity, medication, socio-environmental factors). The relatively small groups of females did not allow for full-scale comparison based on gender. Another possible bias is that we analyzed single measure of personality using a self-report questionnaire to assess personality functioning. On the other hand, the advantage of using the questionnaire is that the format of the questionnaire remains constant over time, whereas interviewers may change and the use of dimensional scores makes it feasible to give more insight into the direct effects of treatment instead of using a dichotomous approach. On the other hand, it is important to note that other personality scales were used in previous studies, as for the dimensional scale of Temperament and Character Inventory (TCI). Future studies are needed in order to improved the quality of the results in terms of comparability. The rehabilitation program of Mondo X Sardegna is not based on a structured univocal model of reference and this make difficult to interpret data on efficacy of the treatment program and to compare results with previous studies focused on treatment efficacy. Anyway, the assessment of the efficacy is beyond the aim of this study.

The main result of the present study is that PD traits reduced after one year of treatment. It can be explained by two hypothesis: 1) treatment works somehow and it is able to reduce both the use of substance and temper some pathological personality traits; 2) the use of substance is able to potentiate some PD traits. When the use of substance dramatically reduces until the long-term abstinence, the personality traits can limit their clinical relevance.

Conclusions

These results show that all personality dimensions except Narcissistic PD in drug abusers significantly change after 1 year of community treatment. Significant differences exist on change in personality dimensions according to the drug-of-choice. Cocaine and Cannabis abusers seem to be the most resistant groups. Heroine abusers showed improvement in PD of the cluster A and B, while Alcohol addicts showed changes in cluster A and C.

The present study tries to underline the potential links between personality and drug-of-choice and changes of personality over time. This is interesting in order to design optimal strategies in preventive care, and, since both PD and SUD may be associated with specific neurobiological mechanisms, it could also serve to better understand the complexities of addictive behaviours and the potential link with specific personality patterns.

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