



## Cerebral edema in drug addicts

## Edem mozga kod zavisnika od droge

Dragana J. Daruši\*, Danka M. Radulović†, Ivana D. Radovanović‡

\*Private General Practice, SO-VIL, Novi Sad, Serbia; †Faculty for Special Education and Rehabilitation, University of Belgrade, Belgrade, Serbia; ‡Criminology and Police Academy, Belgrade, Serbia

### Abstract

**Background/Aim.** The effect of drugs leaves permanent consequences on the brain, organic in type, followed by numerous manifestations, and it significantly affects the development of mental dysfunctions. The clinicians are often given a task to estimate a patient's personality during treatment or during experts estimate of a drug addict. The aim of this research was to determine the differences, if any, in characteristics of addicts experience and personality traits in drug addicts with or without cerebral edema. **Methods.** The research was conducted on a sample of 252 male drug addicts, the average age of 23.3 (SD = 4.3) years. Cerebral edema was confirmed on magnetic resonance (MR) images of the brain performed during the treatment of the addicts. The participants were tested by the psychologists using Minnesota Multiphasic Personality Inventory (MMPI-201) test, and the data were processed using canonical discriminant analysis within the SPSS program. The dependent variable in the study was cerebral edema. A block of independent variables, designed for the requirements of this study, consisted of two subgroups. The first one consisted of 12

variables describing the relevant characteristics of drug abuse. The second subgroup consisted of 8 psychopathological tendencies in the personality defined by the mentioned test. **Results.** Cerebral edema was confirmed in 52 (20.63%) of the drug addicts. The differences between the groups of drug addicts with and without cerebral edema were determined in the following: the time span of taking drugs (0.301), use of alcohol parallel with drugs (0.466), and treatment for addiction (0.603). In the drug addicts with a cerebral edema, MMPI-201 confirmed the increase in the scales for hypochondria, psychopathic deviations and psychastenia, and the decrease in the scales for schizophrenia and depression. **Conclusion.** Our study confirmed a possible connection between cerebral edema and personality traits in a number of the examined drug addicts. Considering the fact that practice often requires personality estimation, regardless whether it is about treatment or expert's estimate, it is necessary to further research in this direction.

### Key words:

brain edema; substance-related disorders; personality disorders.

### Apstrakt

**Uvod/Cilj.** Dejstvo droge ostavlja trajne posledice organskog tipa, na mozak, praćene brojnim neurološkim manifestacijama, i bitno utiče na razvoj psihičkih poremećaja. Kliničarima se često postavlja zadatak da procene ličnost tokom lečenja ili veštačenja zavisnika od droge. Cilj istraživanja bio je utvrđivanje karakteristika narkomanskog staža i osobina ličnosti kod zavisnika od droge sa i bez edema mozga. **Metode.** Istraživanje je sprovedeno u grupi od 252 zavisnika od droge muškog pola, prosečne starosti 23,3 (SD = 4,3) godine. Za vreme lečenja zavisnika od droge rađena je magnetna rezonanca mozga, a za procenu psihopatoloških tendencija ličnosti korišćen je *Minnesota Multiphasic Personality Inventory* (MMPI-201) test. Za obradu podataka korišćena je kanonička diskriminativna analiza u sklopu SPSS programa. Zavisna varijabla u istraživanju bio je edem mozga. Blok nezavisnih varijabli, sačinjen za potrebe ovog istraživanja, sastojao se od dve podgrupe. Prvu je činilo 12 varijabli kojima se opisuju

relevantna obeležja zavisnosti od droge. Drugu je činilo 8 psihopatoloških tendencija ličnosti definisanih pomenutim testom. **Rezultati.** Edem mozga utvrđen je kod 52 (20,63%) zavisnika od droge. Razlike između grupa zavisnika od droge sa i bez edema mozga utvrđene su u dužini narkomanskog staža (0,301), korišćenju alkohola paralelno sa drogama (0,466) i lečenju zavisnosti (0,603). Kod zavisnika od droge sa cerebralnim edemom na MMPI-201 testu utvrđene su povišene skale hipohondrije, psihopatske devijacije i psihastenije, a sniženje skala šizofrenije i depresije. **Zaključak.** Kod jednog broja ispitivanih zavisnika od droge potvrđena je sumnja u mogućnost povezanosti edema mozga i osobina ličnosti. S obzirom na to da praksa često iziskuje potrebu za procenom ličnosti, bilo da se radi o lečenju ili veštačenju, neophodno je nastaviti istraživanja u ovom pravcu.

### Ključne reči:

mozak, edem; poremećaji izazvani supstancama; ličnost, poremećaji.

## Introduction

Without doubt, drug addiction is accompanied by numerous social, mental and medical disorders. Nowadays, it is almost certainly known that the use of drugs is closely associated with dysfunctions in the functioning of the central nervous system (CNS) and the nervous system in general. Medical practice recognizes many conditions and diseases that could be initiated by or manifested among drug addicts. Most frequently, these manifestations include the crises of consciousness, seizures, ischemic changes in the brain, cerebral edema, polyneuropathy, various forms of metabolopathies, etc.<sup>1</sup>.

Recently, a significant increase in the number of cerebrovascular diseases by the type of ischemia has been noticed among younger population. According to the authorities in this field, uncontrolled and excessive intake of certain medicines and drugs affect this CNS disease. Cerebral edema is a frequent comorbidity of CNS diseases. In this context, the most frequently mentioned drugs are amphetamines, cocaine, phenicyclidine, as well as natural and synthetic medications that have pharmacological effects similar to morphine – the so-called opioids<sup>2</sup>. Data on possible research, closely related to this work could not be found in the literature available to us.

Although cerebral edema is primarily a medical phenomenon, it is not absolutely independent on the individual physiological features. Sufficient proof of this is the fact that drug abuse has an important place in the etiology and mechanism of its formation. Long-term experience in working with drug addicts motivated the authors to research possible influence of cerebral edema on personality traits. The reason for this is that drug addicts often suffer from various neurological disorders, and that their treatment requires team work and more often than not the expertise of the committed felony. Consequently, the nature of the research calls for setting up one general and two specific hypotheses, in accordance with the groups of independent variables. The general hypothesis relates to the joint role of variables of the drug addicts' experience and personality traits as follows: There is a significant, but limited contribution of situational and personal factors to differentiating between the incidences of cerebral edema in drug addicts. The first particular hypothesis concerns the variables in drug addicts' experience: Variables that are typical of drug addicts significantly affect the differentiation of drug addicts with or without edema. The other particular hypothesis that refers to personality traits is as follows: The personality traits that bear the character of pathological tendencies have no effect on the distinguishing addicts with or without cerebral edema. Due to the mentioned, the aim of this study was to determine the existence of differences in the characteristics of addicts' experience and personality traits among drug addicts with or without cerebral edema.

## Methods

The investigation was conducted from 2007 to 2012 on 252 male drug addicts, aged between 19 and 25, average 23.3 (SD = 4.3) years of age. Male addicts were selected for

the purposes of the research, because, according to the experience of the authors, they outnumber female addicts in both drug abuse and committing felony, and are as such more available for the research. The patients had been hospitalized, semi-hospitalized and treated in out-patient clinics in a number of health institutions: Clinic for Psychiatry and Mental Health in Novi Sad, private institutions for treatment of addiction such as "Dr Vorobljev" Hospital in Zemun, "Lorijan" Hospital in Belgrade; "Vita" Hospital in Novi Sad; SO-VIL General Practice (GP) Office, and at the extended home treatment in Dispensaries "Novi Sad" in Novi Sad. The data were processed only for the purposes of this research in the SO-VIL GP Office in Novi Sad. During the treatment of addicts whose clinical manifestations were the basis for a reasonable doubt that they suffer from CNS ailment, magnetic resonance imaging (MRI) of the brain was required. Most frequent issues addicts complained about were a diffuse headache, varying in intensity and duration, feeling of tension in the head, occasional vertigo, nausea, tinnitus, and photophobia. The neurological examination was within the physiological limits. MRI confirmed the cerebral edema, while other CNS diseases (head injuries, anomalies and brain tumors) and similar were not confirmed. Cerebral edema was diagnosed in 52 (20.63%) of the cases.

The psychologists who professionally estimated addicts' personality used the Minnesota Multiphasic Personality Inventory (MMPI-201). The test has 11 scales of which the first 8 measure classical psychopathic personality dimensions, while the remaining 3 scales are control scales and are designed to assess the validity of the obtained materials of the test material<sup>3,4</sup>. The data about the addicts' experience were collected in a specially designed questionnaire, thought up based on the experience of the researchers, and adapted to the needs of this research. The dependent variable is a binary-encoded data about cerebral edema. It is a category variable and that is why the analysis of the difference among subjects who are and are not diagnosed with cerebral edema is done using a canonical discriminate analysis. The independent variables comprise two groups of dimensions contained in the previously mentioned questionnaire. The first group that describes the addict's experience is marked with factors that define the shape of the addiction of the given individual. They are: age when first using drugs; length of drug use (in months); frequency of drug use; the amount of drugs used daily; using alcohol along with the drugs; using tablets along with drugs; using cocaine; venous drug application; whether he or she was treated for addiction; length of abstaining periods; using blockers of opiate receptors; using methadone. The first 4 variables are numerical and the others are categorical. Each category is especially binary coded (and thus became a new variable) to be available for the foreseen model of data analysis<sup>5</sup>.

The second group is related to the personality traits of psychopathological connate space. The instrument that was used in the process of psychological expertise (MMPI-201) is approximated by the following 8 properties: hypochondria, depression, hysteria, psychopathic deviation, paranoia, psychastenia, schizophrenia, hypomania, while the function of

the last 3 dimensions: defense mechanism, rigidity and confused thinking is to check the validity of the protocol.

All the properties have the form of interval scales. The result of the subjects at subtests that measure these dimensions is expressed as a total score at each of the subscales.

For the research into the difference among the forms of cerebral edema of drug addicts within the variables of addicts' experience and personality traits, the canonic discriminate analysis was used within the SPSS programmed for statistical processing of data.

## Results

The analysis of differences in the addicts experience and personality traits between the drug addicts who have or do not have a diagnosed cerebral edema begins with a matrix of univariate tests of equality of arithmetic means of the group of addicts with or without cerebral edema at each independent variable as shown in Table 1.

these differences suggest that there will be a total discrimination between the two groups.

According to the results obtained in this paper for the existence of differences in the diagnose of cerebral edema in the drug addicts, in the space that is defined by some variables of their experience and pathological tendencies in their personality, one canonical dimension is responsible ( $\lambda = 0.269$ , Wilks lambda 0.788,  $\chi^2 = 56,810$ ,  $p < 0.000$ ), the canonical correlation which was 0.460. This dimension could explain 21.16% of the variance of the existing differences.

The meaning of that discriminate function is determined by standardized canonical discriminate coefficients of independent variables, and the orthogonal projections of these variables on the discriminate function. In the first case, it is about the so-called regression ponders, and in the other about the correlations of the variables with the function, i.e. about the structure of the discriminate function. These results are given in Table 3.

**Table 1**  
**Characteristics of experience among the addicts with/without cerebral edema[0]**

Characteristics of addicts	Wilks' lambda	F	Significance
Age of the first using drugs	0.978	5.519	0.020
Length of drug use	0.929	19.195	0.000
Frequency of drug use	0.983	4.359	0.038
The amount of drugs used daily	0.956	11.384	0.001
Using alcohol along with the drugs	0.975	6.504	0.011
Using tablets along with drugs	1.000	0.077	0.781
Using cocaine	1.000	0.068	0.795
Intravenous drug administration	0.962	9.950	0.002
Treatment for addiction	0.999	0.127	0.722
Length of abstinence	0.975	6.479	0.012
Using blockers	0.992	2.046	0.154
Using methadone	0.994	1.481	0.225

**Table 2**  
**Characteristics of personality traits among addicts with/without cerebral edema[0]**

Characteristics of personality traits	Wilks' lambda	F	Significance
Hypochondria	0.995	1.999	0.275
Depression	0.995	1.265	0.262
Hysteria	1.000	0.001	0.977
Psychopathic deviation	0.992	2.043	0.154
Paranoia	0.999	0.226	0.635
Psychastenia	1.000	0.071	0.790
Schizophrenia	0.989	2.880	0.091
Hypomania	0.999	0.249	0.618
Defense mechanism	1.000	0.003	0.953
Rigidity	0.999	0.300	0.584
Confused thinking	0.994	1.465	0.227

The matrix univariate tests of equality contains a summarized one-way analysis of variance for each variable. Univariate tests are not identical to the actual F-tests, because they are derived from the existing discriminatory solution and do not have a particular significance because of this and because derivativeness of univariate quality, apart from indicating that with some variables there were significant differences in the average values between the groups and that

Judging from the coefficients obtained the substantial contribution to the function of separating addicts with and without cerebral edema are the variables that define the addicts experience, while the results obtained through variables analysis which describe psychopathological tendencies of personality have significantly lesser predictive power apart from hypochondria, depression, psychastenia (Table 3).

**Table 3**

**Canonical discriminate function of characteristics in the group of addicts with/without cerebral edema[0], their experience and personality traits**

Variables	Discrim. coefficient	Structure of function
Age of the first using drugs	-0.277	-0.286
Length of drug use (in months)	0.301	0.534
Frequency of drug use	-0.042	0.255
The amount of drugs used daily	0.241	0.411
Using alcohol along with the drugs	0.466	0.311
Using tablets along with drugs	-0.087	-0.034
Using cocaine	0.152	0.385
Intravenous drug administration	-0.269	0.032
Treatment for addiction	0.603	-0.044
Length of abstinence	0.297	0.310
Using blockers	-0.698	-0.175
Using methadone	-0.394	-0.148
Hypochondria	-0.493	-0.134
Depression	0.455	0.137
Hysteria	0.093	-0.004
Psychopathic deviation	-0.223	0.174
Paranoia	-0.025	0.058
Psychastenia	-0.359	-0.033
Schizophrenia	0.542	0.207
Hypomania	-0.075	-0.061
Defense Mechanism	0.203	0.007
Rigidity	-0.024	-0.067
Confused Thinking	0.019	0.148

Based on the prognostic power of an isolated function, centroids of the groups on the discriminate function and the results of the classification of addicts into the two groups speak of the nature and the role of influences of the drug addicts experience variables and pathological tendencies in the personality on differentiating the addicts with and without cerebral edema. The data on the group centroids show that there is a clear difference in the experience of addicts and pathological tendencies in personality between addicts groups with cerebral edema (1.013) and without cerebral edema (-0.263). The predicted affiliation was confirmed with 74.6% of successfully grouped drug addicts. As far as the results of the classification made on the basis of discriminate functions, there is a satisfactory level of agreement between both procedures. The success of this method lies in the fact that, based on the isolated latent dimension and utilized sample of independent variables, one can recognize the real situation and place the vast majority of addicts in groups, where they belong, based on the objective diagnosis.

### Discussion

The results unambiguously confirm that certain variables of the addicts experience and pathological tendencies of personality have significant canonical discriminate coefficients with a function responsible for the differentiation of drug users with and without a diagnosed cerebral edema.

In the case of variables used to analyze the drug experience, we confirmed that the use of drugs has an impact on the occurrence of edema due to biochemical processes during intoxication of the nervous system. It is therefore logically that the drug as an external stimulus appears as an outer risk factor. This study suggests that it involves a small part of that variance, not only because the canonical correlation of the

discriminate function is relatively low, but also because the drugs are only one of the conditions that are to be met for the occurrence of edema.

What is surprising is the direction of the impact of some of these variables on the creation of these differences. Judging by the signs of canonical coefficients (and correlations), and bearing in mind that the input data are numerated, these unexpected results indicate that the cerebral edema will be more frequently found in drug addicts who started using drugs later (aged 18–20) rather than earlier in life (aged 13–18), and who have spent less time in drug use and take smaller amounts of drugs on a daily basis. A question arises as to whether a complete maturation of the brain after 18 years of age, is also a better ground for the development of cerebral edema, rather than a younger age, when the development of the brain is not yet complete. What is also surprising is that using pills (sedatives, psychostimulants, analgesics, antipsychotics, etc.) along with drugs played no role in the differences of the variables formation. Considering the particularity of the relations that we analyzed, in quotes from literature available to us and in the journals that deal with this issue, we found no data that could be compared with our results. The direction of the impact of other variables of the addicts experience is expected and it is easy to understand: the use of alcohol along with drugs, cocaine use, lack of treatment and lack of abstinence increase the likelihood of cerebral edema and, consequently, its effect on the characteristics and behavior of addicts<sup>6–8</sup>.

When the pathological tendencies in the person are concerned, the direction of defining the functions (discriminate coefficients) shows that high hypochondria, psychopathic deviations and psychastenia, and low depression and schizophrenia confirm the differences in the existence of cerebral edema. Hysteria, paranoia, hypomania, rigidity and

lenience to confused thinking had zero impact on those differences. The mentioned claims point to the existence of interconnectedness of the examined relation. Given the clinical importance and the nature of the independent variables, the scope of 21.16% variance difference, is under no circumstances to be underestimated. For these reasons, the value of the MMPI test scales could contribute to the quality of the experts findings.

Some psychologists do not even recommend the use of the MMPI test (and no other, for that matter) in the case of suspected or proven organicism of any origin even with addiction to drugs. A number of psychologists do not support those claims and in case of need for psychological processing they regularly use this test. The possibility that these results are related to the existence of cerebral edema is certain, because the addict is tested during the treatment or within pre-existing clinical images. Nevertheless, we are confident that the scores were not significantly influenced by these changes and that they reflect the real picture of a personality. For this, there is some important empirical evidence. Firstly, the correlations of some of these properties to a variable 'cerebral edema' are not statistically significant or are very low (paranoid 0.35, psychastenia 0.34, confusing thinking 0.32).<sup>\*</sup> If these properties depended on the cerebral edema there would be correlations with all of them even at the lowest substantial level. Secondly, there are significant differences in arithmetic means of each of these traits among addicts with and without cerebral edema. These differences would have to have existed if cerebral edema had impact on these properties. Thirdly, there are no significant differences in the arithmetic means in any characteristics between the subjects who were addicted to drugs and those who are not<sup>4,6</sup>. This result refutes even the argument that addiction itself changes the structure of personality traits and affect the test results. Unfortunately, we found no results of this relation in the literature available to us, and we could not make comparison.

With this in mind we can claim with certainty that the results of the trend in the personality, which the MMPI covers, are valid. This means that to a significant degree high

hypochondria, psychopathic deviation, psychastenia, and low depression and schizophrenia allow predicting of the differences in the presence of cerebral edema between the two groups of drug users. Variables of addicts experience have the impact to the same degree. We realize that psychopathic tendencies in personalities are predispositions of an individual and characteristics of their personality set, and that the symptoms of organicism are due to the impact of drugs on the brain<sup>1</sup>. The importance of the results is not only of practical but is also of theoretical importance. It refers to the observation that based on personality traits one can predict the existence of changes in the central nervous system. This study shows that there are relationships between mental reality, and its physiological basis, which are mathematically provable, outside laboratories in simple paper-pencil situations.

Cerebral edema was diagnosed in 52 (26.63%) of the cases, which corresponds to the obtained value of the predicted affiliation of 74.6% of the total of the studied drug addicts. The obtained value of the canonical discriminative analysis points to the fact that one canonical dimension, whose canonical correlation of 0.460 is responsible for the existence of the tested relation. This dimension can explain 21.16% of variance in the existing differences.

### Conclusion

The direction towards which function defining (of discriminative coefficients) of the observed psychopathological personality tendencies is going shows that high hypochondria, psychopathic deviation and psychastenia, and low depression and schizophrenia confirm the differences regarding the existence of cerebral edema. The results obtained in this research point to a high importance of the examined relation and also to the fact that Minnesota Multiphasic Personality Inventory test should find an important place in diagnosing and treating drug addicts as well as in experts estimation work. For these reasons, it is important to continue research in this direction.

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<sup>\*</sup>Two of these three features are irrelevant, since only psychastenia solely has influence on a discriminant function.