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Relationships of impulsiveness and depressive symptoms in alcohol dependence

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Abstract

Background—Depressive symptoms as well as high levels of impulsivity are subjects of special interest in alcohol dependence, as these factors are considered to influence the course of this disorder. However, until now mutual relationships between impulsivity and depression have not been investigated thoroughly in alcohol-dependent patients.

Methods—By means of the Barratt Impulsiveness Scale (BIS-11) and *stop-signal task*, levels of impulsivity among 304 alcohol-dependent patients were measured. The *stop-signal task* was used as a manipulation-free method of estimating the level of behavioral impulsiveness, and the BIS-11 is a self report measure of global as well as cognitive impulsivity. Patients were also asked to complete the Beck Depression Inventory (BDI) and Hopelessness Scale (BHS). The results were analyzed in order to examine relationships between impulsiveness and depressive symptoms.

Results—Statistical analyses revealed significant associations between impulsiveness and severity of depressive symptoms. Individuals with higher scores on the BDI were more impulsive on the BIS-11, whereas patients with higher scores on the BHS were more impulsive on both the *stop-signal task* and BIS-11. The strongest correlations were found with the attention impulsivity subscale of BIS-11. Adjusting for other variables, a linear regression analysis revealed that cognitive impulsivity was the strongest predictor of depression severity.

Limitations—The main limitation of the study is a not fully representative sample, with exclusion of patients with active mood disorders

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Conflict of interest

All authors declare that they have no conflict of interest.

Contributors

Drs Wojnar and Brower designed the study. Drs Wojnar, Klimkiewicz, Serafin, Topolewska-Wochowska and Jakubczyk performed the study and collected the data. Drs Sadowska-Mazuryk and Topolewska-Wochowska managed the literature review and contributed to the first draft of the manuscript. Dr Wojnar, Pupek-Pyzio and Jakubczyk conducted the statistical analyses. Drs Jakubczyk, Wojnar and Brower wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conclusions—The results indicate a strong association between depressive symptoms and impulsivity in alcohol-dependent patients, and suggest an important distinction between hopelessness and other depressive symptoms.

Keywords

impulsivity; alcohol dependence; depression; hopelessness

1. Introduction

According to Moeller et al. (2001), impulsivity may be defined as “a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions”. Thinking about a typical depressed patient one can hardly imagine depression has anything in common with this definition of impulsive behavior. However, current research concentrates on impulsivity as a multidimensional construct, distinguishing not only impulsive action (*behavioral impulsiveness* - inability to stop initiated reaction), but also impulsive decisions *(cognitive impulsiveness* - inability to weigh the consequences of one’s behavior) (Arce and Santisteban, 2006), which may have special relevance in the context of depressive symptoms.

To date the relationship between impulsivity and depressive symptoms has been studied mainly in patients with bipolar disorder (BPD), which itself is associated with alcohol dependence (Swann, 2010). Impulsivity measures have been found to be higher in bipolar patients with than without an alcohol use disorder (Rogers et al., 2010). Recent research also shows that impulse control deficits are not limited to manic states (Rogers et al., 2010), but also occur during euthymic periods (Lewis et al., 2009; Swann et al., 2001) and depressive episodes (Strakowski et al., 2010; Swann et al., 2008). This observation may be the key to understand the fact that bipolar disorder is the most common psychiatric condition in patients with substance use disorders (Grant et al., 2004), with impulsivity being a key symptom of both. Research demonstrates that even euthymic patients with bipolar disorder are more sensitive to the euphorigenic influence of psychoactive substances, which may result from increased noradrenergic transmission (especially manifested in manic episodes) (Swann, 2010). These changes in neurotransmission may confer greater susceptibility to positive reinforcement, but also enhance impulse control deficits by inhibiting the frontal lobe function.

Surprisingly, some studies suggest that impulsiveness is not only a characteristic of BPD, but may accompany depressive episodes in both bipolar disorder and recurrent major depressive disorder (Corruble et al., 2003). This observation suggests the existance of a specific mechanism linking depressive episodes and impulsivity. Peluso et al. (2007) have shown that levels of impulsiveness in individuals with bipolar depression differ neither from levels of impulsivity among patients in remission, nor from levels in patients with recurrent depression. In all these cases impulsivity has been shown to have higher levels than in healthy controls (Peluso et al., 2007). In addition, Matthews et al. (2009) as well as Yang et al. (2009) described altered functioning in the anterior cingulate cortex (which is involved in inhibitory control) in patients performing a stop-signal task during an episode of major depression. Gonzalez et al. (2011) observed a significant association between depressive symptoms and negative urgency (a state-specific impulsivity related construct, referring to difficulty in controlling behavioral impulses when emotionally upset) in a group of college drinkers with depressive symptoms.

Although results of some studies suggest that impulsivity in depressed subjects results from the presence of subtle manic symptoms in mixed states (Akiskal et al., 2005; Goldberg et al.,

2009; Swann, 2009), other studies point to differences in the types of impulsiveness observed in manic and depressive episodes. In manic episodes an increase in behavioral impulsivity has been observed (Swann et al., 2008) whereas cognitive impulsiveness has been reported to accompany depression (Corruble et al., 2003; Lau et al., 2007; Swann et al., 2008). Neither self-report (Corruble et al., 2003; Swann et al., 2008) nor objective measures (Lau et al., 2007) revealed increases in behavioral impulsivity during depressive episodes.

An explanation for this phenomenon has yet to be established. Some authors (Swann et al., 2002; Swann et al., 2008) emphasize that lack of planning (the inability to think about the consequences of one's behavior, the core element of cognitive impulsivity) may be symptomatic of depression, coming from feelings of helplessness and hopelessness regarding future events. According to one theoretical model, depression may be perceived as a result of loss of control over negative thoughts (Lau et al., 2007). In a study by Swann et al. (Swann et al., 2008), high levels of impulsiveness correlated significantly with hopelessness, anhedonia, and suicidality. Moreover, some authors suggest (Rzewuska, 2005) that behavioral manifestations of impulsivity (aggression, lost of control over one's behavior) may appear during early periods of a depressive disorder as equivalents of low mood. In addition, impulsivity is considered to be an important risk factor of suicidal behavior (Baca-Garcia et al., 2005; Dougherty et al., 2004; Mann et al., 1999; Najt et al., 2007). Indeed, suicidal behavior can be viewed as a manifestation of both severe depression and, in some cases, as severely deficient impulse control.

Suicide attempts may possibly result from the coexistence of two factors: hopelessness (a common symptom of depression) and impulsiveness (Rzewuska, 2005). A question of whether suicide attempts of impulsive individuals are more harmful than non-impulsive individuals is still a matter of dispute as different studies gave different results (Baca-Garcia et al., 2005; Swann et al., 2005)

It has to be emphasized that depressive symptoms as well as high levels of impulsivity, are important risk factors for relapse in alcohol dependence (de Wit, 2009; Nigg et al., 2006; Nunes and Levin, 2004; Rubio et al., 2008; Simons et al., 2004; Swann, 2010; Witkiewitz and Villarroel, 2009). The definition of impulsiveness overlaps at least two symptoms of alcohol dependence according to ICD-10 (World Health Organization, 1992) and DSM-IV (American Psychiatric Association, 2000) criteria: drinking more than previously planned and drinking despite knowledge of negative consequences. This explains and emphasizes the significance of impulsivity in the course of alcoholism. On the other hand, depression may exert its effect on drinking by leading to alcohol use that is an attempt to avoid negative affect (drinking to cope, self-medication) or manage sleep problems (Gonzalez et al., 2011; Davis et el., 2008). The comorbidity of depression and alcohol use disorders may result in more severe social impairment as well as a higher risk of suicide, which- as mentioned earlier can be also perceived as a manifestation of higher impulsivity (Davis et al., 2008). However, until now mutual relationships between depression and impulsivity have not been investigated thoroughly in alcohol-dependent patients. Considering the importance of impulsivity and depressive symptoms for the course of alcohol dependence and considering results of their correlation in studies of individuals with mood disorders, we decided to investigate this issue in a group of alcohol-dependent patients. Taking into account the definition of impulsivity as a multidimensional construct, we analyzed the relationships between depressive symptoms and two dimensions of impulsiveness: behavioral and cognitive. We hypothesized that the severity of depressive symptoms would be associated with cognitive but not behavioral impulsivity in a group of alcoholics. Given that impulsivity may lead to negative consequences that might, by themselves, increase depression, we also analyzed the effects of selected variables (decreased social support, severity of alcohol dependence, use of other substances, and adverse consequences of

drinking) in order to test our second hypothesis that impulsiveness would remain significantly correlated with depression severity after controlling for these other factors.

2. Method

2.1. Subjects

A group of 304 patients entering abstinence-based, drug-free alcohol treatment programs in Warsaw, Poland, were recruited into the study. Most of them (n = 270) came from residential treatment centers whereas 34 patients were recruited from outpatient clinics. Participation in the study was completely voluntary and confidential. All subjects signed informed consent after becoming acquainted with the protocol. The study received approval from both the Medical Institutional Review Board at the University of Michigan and the Bioethics Committee at the Medical University of Warsaw. All patients who qualified for the study had a current DSM-IV diagnosis of alcohol dependence. Individuals with active comorbid psychiatric disorders other than alcohol dependence (e.g., depressive or manic episodes, psychosis) were excluded from the study on the basis of clinical observations and results of the MINI International Neuropsychiatric Interview (Sheehan et al., 1998). In addition, subjects under 18 years of age, or patients with marked cognitive deficits (scores of 25 or less on the Mini-Mental State Examination) (Folstein et al., 1975) were not eligible to take part in the study.

2.2. Procedures

All participants completed questionnaires that included information about demographics, alcohol use and problems, use of other substances, depressive symptoms, and impulsivity. In addition, subjects performed the stop-signal task in the presence of a trained member of the research team.

2.3. Measures

I. The level of impulsiveness was measured by the Barratt Impulsiveness Scale and the stop-signal task.

1. The Barratt Impulsiveness Scale (BIS-11) (Barratt, 1959; Patton et al., 1995) was used as a subjective measure of global impulsivity as well as its different dimensions. Six basic factors of impulsivity in the BIS-11 are: motor impulsiveness, attention factor, perseverance, cognitive instability, cognitive complexity and self-control. The three complex factors of impulsivity are combinations of these basic factors: motor impulsiveness (motor impulsiveness as a basic factor and perseverance), non-planning impulsivity (self-control and cognitive complexity) and attentional impulsiveness (attention factor and cognitive instability). In this study the BIS-11 global score as well as scores for the three complex factors of the BIS-11 were analyzed. Based on the definition of behavioral and cognitive impulsivity, motor impulsiveness was treated as an indicator of behavioral impulsivity whereas attentional impulsiveness and non-planning impulsiveness were considered to be indicators of cognitive impulsiveness. Accordingly, cognitive impulsivity was assessed by summing the attentional and non-planning impulsivity subscores.

2. The stop-signal task was used as a manipulation-free method of evaluating the level of *behavioral impulsiveness* (Logan et al., 1984). The stop-signal task tests the ability of stopping a reaction that has already been started. It is administered via a computer program; and the results are presented in milliseconds as *stop reaction time* (StopRT) (Band et al., 2003), which is a

useful indicator of executive functions: the higher its value the higher level of *behavioral* impulsiveness.

II. Depressive symptoms were evaluated with the Beck Depression Inventory (Beck et al., 1996) and Beck Hopelessness Scale (Beck et al., 1974). We evaluated the level of hopelessness to determine if the significant correlation with impulsivity described by Swann et al. (Swann et al., 2008) would hold true for alcohol-dependent patients. In particular, we expected to find a significant correlation with cognitive impulsivity, because hopelessness about the future might interfere with attention to planning for it.

III. The severity and consequences of alcohol dependence were evaluated using a modified version of the Substance Abuse Outcomes Module (SAOM) (Smith et al., 1996) (age at onset of alcohol problems, duration of alcohol dependence), the Michigan Alcoholism Screening Test (MAST) (Selzer, 1971) and the Short Inventory of Problems (SIP) (Derogatis and Melisaratos, 1983). The SAOM also asked about other drug use in the past 28 days, including marijuana, cocaine, other stimulants, opioids, hallucinogens, inhalants, and sedative-hypnotics.

IV. The level of social support was evaluated using the Medical Outcomes Study Social Support Survey (MOSSSS) (Sherbourne and Stewart, 1991).

V. Use of other substances was evaluated by the Fagerstrom Test for Nicotine Dependence (FTND) (Heatherton et al., 1991) and a set of questions from the SAOM addressing use of other drugs during the 28-day period preceding the study.

2.4. Statistical analyses

Statistica software, version 9.0 was used for statistical analyses. All continuous data were checked for normal distributions by means of the Kolmogorov-Smirnov test. Data were presented as arithmetic means and standard deviations (mean ± SD) for parametric variables. For non-parametric variables, data were presented as median and quartiles (25; 75). The main aim of the analyses was to examine associations between the severity of depressive symptoms (BDI, BHS) and the levels of total, behavioral and cognitive impulsiveness in alcohol-dependent patients. In addition, correlations between depressive symptoms and severity of addiction (MAST), consequences of alcohol dependence (SIP), other substance use (FTND, SAOM) and social support (MOSSSS) were examined. All variables that were significant in analyses of correlation as well as control demographic variables (age, gender) were entered simultaneously and required to remain in a linear regression analysis in order to determine the most significant predictors of depressive symptoms.

3. Results

The sample consisted of 304 patients (74% males) with a mean age of 43.46 ± 9.66 years (range: 23 to 73 years). All patients were Caucasian. The median education level was 12 years (the last level of secondary school in Poland). The mean age of onset of drinking problems was 21.0 years. The symptoms of alcohol dependence lasted for 19.2 years on average. Demographic and clinical characteristics of the study group are presented in Table 1.

The statistical analysis revealed a significant association between the level of global impulsivity as measured by the BIS-11 and severity of depressive symptoms in the BDI ($r = 0.483$, $p < 0.0005$; see Table 2). In addition, significant correlations for all three BIS-11 subscales were observed (see Table 2), with a stronger correlation between attentional impulsivity and BDI scores ($r = 0.541$, $p < 0.0005$), and a weaker correlation with motor impulsivity ($r = 0.275$, $p < 0.0005$). There was no significant correlation between the

objective measure of behavioral impulsivity (StopRT) and total BDI scores ($r = 0.053$, $p = 0.389$).

Analyses of the BHS indicated significant associations with global impulsiveness ($r = 0.282$, $p < 0.0005$) as well as with all three subscales of BIS-11 (see Table 2). Similar to the correlations with the BDI, attentional impulsivity was more highly correlated with BHS scores ($r = 0.312$, $p < 0.0005$), than motor impulsivity ($r = 0.139$, $p < 0.002$). In contrast to BDI scores, however, we found a significant association between the BHS and the StopRT value ($r = 0.21$, $p = 0.001$).

Among other analyzed variables, severity of alcohol dependence (MAST), consequences of alcohol dependence (SIP), nicotine dependence (FTND), duration of alcohol dependence, and social support (MOSSSS) were significantly associated with BDI scores (see Table 3). Severe consequences of drinking ($r = 0.424$, $p < 0.0005$) and low social support ($r = -0.367$, $p < 0.0005$) were most strongly correlated with depressive symptoms (BDI). We did not observe a significant difference in the severity of depressive symptoms between early and late onset alcoholics ($p = 0.44$, $df = 209$, $t = 0.765$) and patients who did and did not report taking other drugs during the 28-day period preceding the study ($p = 0.5$, $df = 299$, $t = -0.666$).

All significant variables in the correlations analyses with BDI score (BIS, SIP, FTND, MAST, duration of alcohol dependence) as well as age and gender were entered into a linear regression analysis, which showed that cognitive impulsivity (evaluated by summing attentional and non-planning impulsivity subscores in BIS-11) was the strongest predictor of depressive symptoms severity (beta = 0.332, $p < 0.0000005$). Consequences of alcohol dependence (SIP) (beta = 0.267, $p = 0.000008$), social support (MOSSSS) (beta = −0.259, $p = 0.000001$) and gender (beta = −0.140, $p = 0.015$) also remained significant after adjustment for other variables (see Table 4).

4. Discussion

Our study revealed a significant association between severity of depressive symptoms and levels of impulsiveness as measured by the BIS-11. As hypothesized, the strongest correlation was noted in subscales associated with cognitive impulsivity. At the same time, we did not observe a significant association between behavioral impulsivity as measured by the stop-signal task and depressive symptoms, which is consistent with results of studies including individuals with bipolar disorder (Corruble et al., 2003; Swann et al., 2008). To the best of our knowledge, there has been only one study to date concerning this issue in alcohol-dependent subjects. Liu et al. (2010) described higher levels of impulsiveness (BIS-11) in alcoholic patients with comorbid depression as compared to subjects without comorbidity.

There are several possible explanations of this interesting phenomenon. We investigated some of them by looking into other variables that may theoretically link impulsivity with depressive symptoms. One possible explanation is that more impulsive people experience more severe consequences of alcohol drinking and therefore they have more reasons to feel depressed. These individuals are also theoretically more prone to conflicts, have less social support and experience a more severe course of alcohol dependence (a longer duration of problem drinking that started earlier in life). All these variables were significantly associated with BDI scores, but cognitive impulsiveness as measured by the BIS-11 remained the strongest predictor after adjusting them in the regression analysis.

The BIS-11 is a subjective scale, allowing patients to present their own assessments or interpretations, which usually are affected by mood and general mental condition. Higher

BIS scores in depressed individuals could possibly result from negative self–esteem as impulsive behaviors are usually considered to be disadvantageous rather than rewarding. It is interesting to note that there was no association between BDI scores and stop reaction times (which independently measure behavioral impulsivity). At the same time we observed a significant, albeit small, correlation between BIS-11 motor impulsivity and BDI scores. A tendency to present oneself in a negative light might have contributed to this effect. A very useful behavioral measure of impulsivity is delay discounting, which assesses preference for smaller and immediate reward over a larger but delayed one (de Witt et al., 2009). We hypothesize that a study employing this objective measure of cognitive impulsivity would find that alcohol-dependent patients with higher levels of depressive symptoms would more likely make impulsive decisions than those with lower levels. Takahashi et al. (2008) observed that depressive (but not alcohol-dependent) individuals were more impulsive in their choices for monetary gain and loss, which is consistent with our findings. In fact, some authors do emphasize that cognitive impulsivity may be placed in the spectrum of depressive symptoms (Swann et al., 2002; Swann et al., 2008). Especially, attentional impulsivity and non-planning impulsivity seem to be theoretically associated with depressive symptoms. Lack of planning (non-planning impulsivity) may result from the general inability to place oneself in future, while attentional impulsiveness may possibly come from transient cognitive deficits (e.g., difficulties with concentration), quite common in depression and leading sometimes to so called pseudo-dementia". Subscales of these two dimensions of impulsivity were more strongly associated with severity of depressive symptoms than motor impulsivity in our study. In addition, impulsivity has been suggested to be a possible consequence of anxiety, which is an important symptom of depression. According to the cognitive style of "reflectivity-impulsivity" formulated by Kagan (1964), the level of impulsivity increases in situations considered to be difficult and associated with fear. In this model, a strong relationship between impulsiveness and negative self-esteem is also emphasized. Recently Taylor et al. described a significant association between anxiety and impulsivity as measured by the BIS-11 in patients with bipolar disorder (Taylor et al., 2008). Therefore, the results of our study are consistent with these results and the Kagan's theory.

We observed that BHS scores correlated significantly with BIS-11 scores, including the dimension of cognitive impulsivity, although not as strongly as BDI scores did. These correlations replicate and extend the findings of Swann et al. (2008) to a sample of alcohol-dependent patients. Moreover, a significant association of hopelessness with behavioral impulsiveness as measured by the stop-signal task was revealed. These findings suggest that hopelessness should be differentiated from other depressive symptoms as it might lead not only to "impulsive decisions" (cognitive impulsivity), but also to "impulsive activity" (for instance, a suicidal attempt).

The correlation between impulsivity and depression may stem from a common pathophysiological abnormality: hypoactivity of the serotonin system (Van Praag, 1994). Depressed patients with higher levels of impulsiveness had lower levels of serotonin activity (decreased 5-HIAA concentrations in urine) (Rzewuska, 2005). According to Van Praag (1994), serotonin activity is lower in depressed individuals with coexisting impulsivity than in individuals with either depression or impulsiveness alone.

Our study should be interpreted in the context of its limitations. The main limitation is that our sample is not fully representative of all individuals with alcohol dependence, in part because treatment programs in Poland exclude patients with active mood disorders. Accordingly, the mean BDI score was about 19 points, which indicates depressive symptoms of a mild severity. The results of our study should be replicated in other samples of alcohol-dependent patients, including those with co-occurring mood disorders.

In conclusion, our results indicate a strong association between depressive symptoms and impulsivity in alcohol-dependent patients. The relationship between depressive symptoms in general applies mainly to cognitive impulsiveness, which reflects impulsive decisions rather than impulsive actions. The relationships between hopelessness and impulsiveness, however, extended to objectively measured behavioral impulsiveness as well as self-reported cognitive impulsiveness, suggesting an important distinction between hopelessness and other symptoms of depression. These findings may shed new light on mutual relationships among impulsivity and depression in alcohol-dependent patients, emphasizing the significance of evaluating the feeling of hopelessness in clinical practice. This may be perhaps useful in screening for individuals with a higher risk of making an impulsive suicide attempt (Wojnar et al., 2009). However, because of the limitations of the study, our findings should be treated as preliminary results, and should be investigated thoroughly in longitudinal, controlled studies.

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Table 1

Demographic and clinical characteristics of the study group of alcohol-dependent patients.

Characteristic	Study group N = 304
Age (years)	43.46 ± 9.66
Age of onset of drinking problems (years)	21 (18;28)
Duration of alcohol dependence (years)	19.21 ± 9.86
Consequences of alcohol dependence (SIP)	23.7 ± 11.6
Social support (MOSSSS)	62.09 ± 18.21
Severity of alcohol dependence (MAST)	34.57 ± 9.58
Severity of depressive symptoms (BDI)	18.72 ± 11.39
Feeling of hopelessness (BHS)	4 (2;8)
Global impulsivity (BIS-11)	71.52 ± 9.81
Behavioral impulsivity (StopRT) (ms)	216.32 ± 60.52

BIS-11 – Barratt Impulsiveness Scale, StopRT – stop reaction time, BDI – Beck Depression Inventory, BHS – Beck Hopelessness Scale, MOSSSS – Medical Outcomes Study Social Support Survey, SIP – Short Inventory of Problems, MAST - Michigan Alcoholism Screening Test

The values are presented as means and standard deviations (mean± SD), for non-parametric variables are presented as median and quartiles (25;75).

Table 2

Relationships between severity of depressive symptoms and different dimensions of impulsivity in alcohol-dependent patients

	Behavioral impulsivity (StopRT)	Global impulsivity (BIS-11)	Attentional impulsivity (BIS-11)	Motor impulsivity (BIS-11)	Non-planning impulsivity (BIS-11)	Cognitive impulsivity (BIS-11)
BDI	0.053	**0.483**	**0.541**	**0.275**	**0.387**	**0.501**
	p = 0.389	**p < 0.0005**	**p < 0.0005**	**p < 0.0005**	**p < 0.0005**	**p < 0.005**
BHS	**0.21**	**0.281**	**0.312**	**0.139**	**0.245**	**0.306**
	p = 0.001	**p < 0.0005**	**p < 0.0005**	**p = 0.002**	**p < 0.0005**	**p < 0.0005**

BIS-11 – Barratt Impulsiveness Scale, StopRT – stop reaction time, BDI – Beck Depression Inventory, BHS – Beck Hopelessness Scale.

Cognitive impulsivity - calculated by summing the attentional and non-planning impulsivity subscores.

Results of correlation analysis: for BHS - the ***Spearman*** rank ***correlation*** coefficient “R” is presented, for BDI – Pearson’s linear correlation coefficient “r”.

p-values < 0.05 are bolded

Table 3

Relationships between severity of depressive symptoms and different variables that may contribute to impulsivity and depression in alcohol-dependent patients.

	Social support (MOSSSS)	Consequences of drinking (SIP)	Smoking (FTND)	Severity of alcohol dependence (MAST)	Duration of alcohol dependence
BDI	**r = − 0.367**	**r = 0.424**	**r = 0.155**	**r = 0.23**	**r = 0.143**
	p < 0.0005	**p < 0.0005**	**p = 0.017**	**p < 0.0005**	**p = 0.028**

BDI – Beck Depression Inventory, MOSSSS – Medical Outcomes Study Social Support Survey, SIP – Short Inventory of Problems, MAST - Michigan Alcoholism Screening Test, FTND - Fagerstrom Test for Nicotine Dependence

Results of correlation analysis: Pearson's linear correlation coefficient "r".

p-values < 0.05 are bolded

Table 4

Multifactorial model of linear regression analysis for the prediction of BDI score.

Predictive factor	Beta	p
Cognitive impulsivity	**0.332**	**<0.0000005**
Consequences of alcohol dependence (SIP)	**0.267**	**0.000008**
Social support (MOSSSS)	**− 0.259**	**0.000001**
Gender	**−0.140**	**0.015**
Severity of alcohol dependence (MAST)	0.071	0.241
Duration of alcohol dependence	0.053	0.477
Age	0.037	0.600
Smoking (FTND)	−0.001	0.979

Cognitive impulsivity - calculated by summing the attentional and non-planning impulsivity subscores.

BDI – Beck Depression Inventory, MOSSSS – Medical Outcomes Study Social Support Survey, SIP – Short Inventory of Problems, MAST - Michigan Alcoholism Screening Test

FTND - Fagerstrom Test for Nicotine Dependence

p-values < 0.05 were bolded

Non-parametric values were logarythmized before being put to the regression analysis

Linear Regression Model:

dependent variable: BDI score

$R = 0.64$; $R^2 = 0.41$; cor $R^2 = 0.39$

$F = 19.72$; $df = 8.23$; $p < 0.0000005$