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Impulsivity, risky behaviors and accidents in alcohol-dependent patients

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Abstract

Impulsivity and alcohol drinking are both considered as important predictors of unintentional as well as intentional injuries. However, relationships of impulsivity with risky behaviors and a history of accidents have not been investigated in alcohol dependence. The aim of this study was to analyze relationships between the frequency of risky behaviors and level of behavioral as well as cognitive impulsivity in alcohol-dependent patients. By means of Barratt's Impulsiveness Scale (BIS) and stop-signal task, the levels of cognitive and behavioral impulsivity among 304 alcohol-dependent patients were measured. Also, patients were asked to answer questions from the Short Inventory of Problems applying to risky behaviors and accidents after alcohol drinking. In addition participants completed a questionnaire to assess frequency of other behaviors from the analyzed spectrum (use of other drugs, driving or aggressive behavior after alcohol drinking). The statistical analysis revealed a significant association between impulsivity and frequency of risky behaviors in alcohol-dependent patients. Individuals with higher scores in BIS behaved more frequently in a risky way and had significantly more accidents after alcohol drinking. The association with risky behaviors was strongest for non-planning and attentional impulsivity subscales, whereas frequency of accidents was particularly associated with motor impulsivity. A multivariate analysis revealed that impulsivity was the most important predictor of risky behaviors, but did not significantly predict a history of accidents. Our study confirms that impulsivity is an important correlate of risky behaviors in alcohol-dependent individuals, along with global psychopathology and severity of alcohol dependence.

Keywords

impulsivity; risky behavior; accident; alcohol dependence; psychopathology

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1. Introduction

According to Moeller et al. (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”. Currently, impulsivity is conceptualized as a multidimensional construct comprising attentional, behavioral and cognitive components. Behavioral impulsivity is associated with an inability to stop reaction that has already been started; cognitive impulsivity - with inability to predict the consequences of one’s behavior (Arce and Santisteban, 2006) and attentional impulsivity – with being unable to stay focused on a specific task (de Wit, 2009). In all types, theoretical and intuitive associations with risky behaviors and accidents can be easily explained. Cognitive impulsivity may be responsible for a decision of starting a potentially harmful activity (so called “risky decision”), motor impulsivity can impede the process of ceasing the risky activity on time, and attentional impulsivity may interfere with proper evaluation of factors influencing the course of already initiated action, thus leading to a potentially harmful accident.

According to Fischoff and Baruch (Fischoff and Baruch, 1992), the most general definition of risk taking is “any action having at least one uncertain outcome” which sounds synonymous to “lack of regard for long term consequences” (Moeller et al., 2001) in impulsive individuals. Interestingly, some dictionary definitions emphasize that risk taking is associated with engaging in behaviors that can be harmful or dangerous, but at the same time provide the opportunity for some kind of outcome that can be perceived positive. If the expectation is for an immediately positive outcome, then this is consistent with another definition of impulsivity, which emphasizes the inability of delaying gratification in impulsive individuals (Moeller et al., 2001). However, impulsivity remains a multidimensional construct, and risk taking may be considered a manifestation of one particular dimension. In the 4-factor “UPPS” Impulsive Behavior Scale by Whiteside and Lynam (2001), for example, the sensation seeking (“S”) subscale includes items such as “I enjoy taking risks” and “I would enjoy fast driving”. Therefore, while impulsive individuals may enjoy taking risks and engaging in dangerous activities, other dimensions (such as Urgency, lack of Premeditation, and lack of Perseverance) also have to be taken into consideration.

These theoretical similarities have been confirmed in a few research studies. Results (Brandau et al., 2011; Constantinou et al., 2011; Kasar et al., 2010; Lev et al., 2008; Wickens et al., 2008) confirmed that traffic offenders were significantly more impulsive than healthy control subjects, and indicated mostly the importance of cognitive impulsivity. In relation to substance use, not only were impulsive individuals more likely to repeat driving under the influence of alcohol (Kasar et al., 2010), but also to accept a ride from another intoxicated (drugs or alcohol) driver (Calafat et al., 2009). A large epidemiologic study in the general population of the United States found that impulsivity is associated with reckless driving (Chamorro et al., 2012). Moreover, it is suggested that traumatic brain injury (which can be a consequence of an accident) may increase impulsivity and contribute to the likelihood of risk-taking behavior (Olson-Madden et al., 2012). The significance of impulsivity as a risk factor for motor vehicle crashes has led to the idea of new prophylactic strategies. In a recent study, Paaver et al. (Paaver et al., 2012) showed that a brief intervention focused on impulsivity may be helpful in preventing speeding. Other studies confirmed an association between impulsivity and risky sexual (Black et al., 2009; Winters et al., 2009) as well as aggressive behavior (Derefinko et al., 2011; Moeller et al., 2001).

Impulsivity is considered to be an important risk factor of drug and alcohol abuse, which itself is regarded as a predictor of risky behaviors (Coghlan and Macdonald, 2010; Hingson

et al., 2008; Poulose and Srinivasan, 2009; Richer and Bergeron, 2009). Remarkably, Coghlan and MacDonald (Coghlan and Macdonald, 2010) observed that in a multivariate model impulsivity was a more significant predictor of unintentional falls than substance use (alcohol, cocaine, marijuana, nicotine). In addition, Poulose and Srinivasan (Poulose and Srinivasan, 2009) reported that sensation seeking (but not Barratt's Impulsiveness Score) was the strongest predictor (stronger than severity of alcohol dependence) of risky behaviors following alcohol use in the group of 300 alcohol-dependent patients in India. Similarly, Velez-Blasini (Velez-Blasini, 2008) observed that stable personality and behavioral dimensions (like impulsivity/sensation seeking or sociability) provide a better explanation for sexual risk-taking than acute alcohol effects.

From these studies it is not clear whether impulsivity or substance use/abuse is a primary factor increasing the likelihood of various risky behaviors. In this context, substance use might be also considered as another risky behavior rather than an independent predictor of other dangerous activities.

Considering clear theoretical associations between alcohol drinking, impulsivity and risky behaviors, surprisingly few studies have investigated mutual relationships among these factors, with, to the best of our knowledge, only one conducted in a group of alcohol-dependent individuals (Poulose and Srinivasan, 2009). The aim of our study was to analyze relationships between risky behaviors and levels of behavioral and cognitive impulsivity in alcohol-dependent patients. Considering the fact that impulsivity involves taking risks without regard to negative consequences, we analyzed both risky behaviors (including driving under the influence) and accidents as one possible negative consequence. We hypothesized that impulsivity would be a stronger predictor of risky behaviors than severity of alcohol dependence. We also hypothesized that cognitive impulsivity would be associated mostly with risky decisions whereas behavioral impulsivity would be associated mostly with accidents. In addition, we analyzed the association between impulsivity in alcohol-dependent patients and other substance use, as a further example of risky behaviors. In order to analyze the independent association between impulsivity and risky behaviors, we included severity of general psychopathology and severity of alcohol dependence in a multivariate model.

2. Material and methods

2.1 Participants

As previously described by Jakubczyk et al. (Jakubczyk et al., 2011), the study entailed a group of 304 adult patients entering abstinence-based, drug-free alcohol treatment programs in Warsaw, Poland; including 270 patients who were recruited in the residential centers, 34 patients from outpatient clinics. Patients from out- and in-patient facilities did not differ in terms of severity of alcohol dependence as measured by the Michigan Alcoholism Screening Test ($F = 0.007$, $df = 1$, $p = 0.93$). The study received approval from the Medical School Institutional Review Board at the University of Michigan and the Bioethics Committee at the Medical University of Warsaw. All patients voluntarily signed an informed consent document after the protocol was explained and their questions answered. Eligible patients had a current diagnosis of alcohol dependence according to the DSM-IV criteria (American Psychiatric Association, 2000). The diagnosis was first established clinically and then confirmed with the MINI International Neuropsychiatric Interview (Sheehan et al., 1998). Patients with a history of psychosis or a co-occurring psychiatric disorder currently requiring medication were excluded from the study on the basis of clinical examination. In addition, patients in acute alcohol withdrawal or with marked cognitive deficits (score of less than 25 on the Mini-Mental State Examination) (Folstein et al., 1975) were not eligible to take part in the study.

2.2 Procedures

Near the time of entry into the addiction treatment program (within the first 48 hours) all participants were asked to complete a questionnaire that included questions concerning demographics, alcohol problems, history of risky behaviors and accidents, comorbid psychopathology, cognitive function 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 levels of impulsiveness were measured by the Barratt Impulsiveness Scale and the stop-signal task.

1) The Barratt Impulsiveness Scale (BIS) (Patton et al., 1995) was used as a subjective measure of global impulsivity as well as its different dimensions. We analyzed three complex factors of impulsivity, which are combinations of 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 both the total BIS scores and scores of the three complex factors of impulsivity were analyzed.

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 to stop a reaction that has already been started. It is administered via a computer program; 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 The general frequency of risky behaviors was associated with two direct questions from the Short Inventory of Problems (Feinn et al., 2003), asking:

- "How many times during last 4 weeks did you behave in a risky way after drinking alcohol?"
- "How many times during last 4 weeks did you have an accident while being under the influence of drugs or alcohol?"

These two questions are part of the "Impulse Control Consequences" subscale of the Short Inventory of Problems (SIP), which consists of three items. The 3-item subscale has been validated in two studies (Feinn et al., 2003; Kenna et al., 2005). The third item, "When drinking, I have done impulsive things that I regretted later", was not relevant to this study, because it required a self-attribution of impulsivity, for which we had other measures as above. Nevertheless, these three items had the strongest relationships to the 12-item Impulse Control Consequences subscale of the Drinker Inventory of Consequences (DrInC), from which the SIP is derived. Moreover, the Impulse Control Consequences Subscale of DrInC was the only subscale to correlate with the Wisconsin Card Sorting Task, a measure of executive functioning (Giancola et al., 1996).

In addition, the last two questions from the MAST (Selzer, 1971) (concerning a lifetime history of being arrested for driving under the influence of alcohol and a lifetime history of being arrested or taken by the police to a "sober room" after alcohol drinking) were used as indicators of risky behaviors.

III The severity of alcohol dependence was evaluated using the Michigan Alcoholism Screening Test (MAST) (Selzer, 1971). The total MAST score was analyzed without the two last questions, which (as mentioned above) were used in analyses as separate indicators.

IV #x02022; IV. Use of other substances was evaluated using a set of questions from modified version of the Substance Abuse Outcomes Module (SAOM) (Smith et al., 1996) addressing use of other drugs during the 28-day period preceding the study.

V The level of general psychopathology was assessed with the Brief Symptom Inventory (BSI), a self-administered, 53-point questionnaire (Derogatis and Melisaratos, 1983). In statistical analysis the General Severity Index (GSI) was included.

2.4 Statistical analysis

Statistica software, version 9.0 was used for statistical analyses. All continuous data were checked for normal distribution with the Kolmogorov-Smirnov test. Data were presented as arithmetic means and standard deviations (SD) for parametric variables. For non-parametric variables, data were presented as median and quartiles (25; 75).

The primary analyses included testing associations between the two major measures of impulsivity (total BIS score and stop reaction time) and the frequencies of risky behaviors and accidents as measured by the two questions from the SIP questionnaire. To control for other potential correlates, associations between risky behaviors and global psychopathology (BSI), age, gender, and severity of alcohol dependence (MAST) were also examined. All variables that were significant in bivariate analyses were entered simultaneously and required to remain in a linear regression analysis in order to determine the most significant correlates of risky behaviors and accidents.

Secondary analyses were performed in order to extend the understanding of the analyzed phenomena. In this phase, we examined associations between the frequency of risky behaviors and accidents, and the levels of different dimensions of impulsivity as measured by three subscales of BIS. Moreover, the relationship between BIS score and the lifetime history of being arrested for driving under the influence of alcohol and a lifetime history of being arrested or taken by the police to a “sober room” after alcohol drinking was examined.

3. Results

The sample consisted of 304 Caucasian patients (74% male) with a mean age of 43.5 ± 9.7 years. The median (interquartile range) education level was 12 (11;14) years, which corresponds to the last level of secondary school in Poland. The mean duration of alcohol dependence in the study group was 19.2 ± 9.9 years with a median age of onset of drinking problems being about 21 (18;28) years. There were no significant differences between the levels of behavioral (StopRT, $p = 0.24$) or BSI-measured global impulsivity between men and women ($p = 0.81$).

3.1 Primary analyses

According to the data, 75.5% of patients behaved in a risky way at least once and 21.5% had at least one accident after alcohol drinking during last 4 weeks; The statistical analysis revealed a significant association between impulsivity and frequency of risky behaviors in alcohol-dependent patients. Individuals with higher scores in BIS endorsed more frequent risky behaviors ($p = 0.000001$, $F = 11.246$, $df = 3$, figure 1) and had significantly more accidents ($p = 0.00067$, $F = 5.868$, $df = 3$, figure 2) after alcohol use. Other factors that turned out to be associated with history of risky behaviors and accidents after alcohol drinking were severity of alcohol dependence ($p < 0.0000005$, $F = 11.811$, $df = 3$, and $p = 0.00015$, $F = 6.964$, $df = 3$, respectively, table 1) and general psychopathology ($p < 0.0000005$, $F = 12.160$, $df = 3$, and $p = 0.001$, $F = 5.488$, $df = 3$). Moreover, male

participants had more risky behaviors and accidents than females ($p < 0.0039$, $F = 4.291$, $df = 1$, and $p = 0.0008$, $F = 11.459$, $df = 1$, respectively, see table 1). Younger patients were significantly more likely to behave in a risky way after drinking alcohol ($p = 0.0026$, $F = 9.189$, $df = 1$), but having an accident was not significantly related to age ($p = 0.069$, $F = 3.318$, $df = 1$, table 1).

A statistical trend for association between global impulsivity and use of other drugs during 28 days before the study ($p = 0.06$, $F = 3.548$, $df = 1$) was found. We observed no association between the level of behavioral impulsivity as measured by the stop-signal task and a history of risky behaviors ($p = 0.18$, $F = 1.797$, $df = 1$) or accidents following alcohol use ($p = 0.08$, $F = 3.046$, $df = 1$).

A multivariate analysis revealed that impulsivity was the most important predictor of risky behaviors (see table 2), with age and severity of alcohol dependence being the other significant factors. Severity of alcohol dependence and level of global psychopathology turned out to be the strongest predictors of an accident after alcohol use, with impulsivity being not a significant factor in this analysis (table 3).

3.2 Secondary analyses

According to the data 41.5% of the study group reported being arrested at least once for driving under the influence of alcohol during lifetime and 59% of patients admitted being arrested or taken to “sober room” after alcohol drinking. We observed a significantly positive association between history of being arrested for driving under the influence of alcohol and total BIS score ($F = 6.195$, $df = 1$, $p = 0.013$; most significant association for non-planning impulsivity, see table 1). Similarly, patients who admitted being arrested or taken to “sober room” after alcohol intoxication scored more highly on the BIS ($p = 0.0014$, $F = 10.337$, $df = 1$, see table 1), with the most significant association found with motor impulsivity.

The association with risky behaviors as measured by two SIP questions was strongest for non-planning ($p = 0.000075$) and attentional ($p = 0.000002$) impulsivity, whereas frequency of accidents was particularly associated with motor impulsivity ($p = 0.0014$, see table 1).

4. Discussion

Results of our study confirm significant relationships between impulsivity and risky behaviors. As hypothesized, the level of impulsivity was the strongest predictor of risky behaviors, even stronger than severity of alcohol dependence. Results of our study are consistent with a novel perspective that impulsivity, not substance use severity, is a primary factor increasing the risk of various risky behaviors in alcohol-dependent patients. In this context, substance use should rather be considered another risky behavior, not the predictor of other dangerous activities.

As expected from theoretical inference, cognitive impulsivity was associated mostly with initiation of a risky behavior whereas behavioral impulsivity – with completed accidents. Consistently, individuals who experienced legal consequences of their impulsive behavior were more impulsive particularly in motor impulsivity subscale, whereas patients who made a decision to drive a car after drinking alcohol (but not necessarily had an accident) were more impulsive particularly in non-planning impulsivity subscale. Cognitive impulsivity, understood as an inability to predict the consequences of one’s behavior, may lead to a decision to start a potentially harmful activity (a “risky decision”) and motor impulsivity can impede the process of ceasing the “risky activity” on time, thus leading to potentially

harmful accident. The association between motor impulsivity and being arrested might reflect the presence of visible behaviors that are likely to attract the attention of the police.

Our results indicate an important distinction between correlates of risky behaviors and accidents, which is a novel and interesting finding. In multivariate models global impulsivity (as measured by total BIS score) was the strongest correlate of risky behavior after using alcohol, but it was not a significant correlate of accidents. In fact it was weakest correlate. For accidents, severity of alcohol dependence, gender and level of global psychopathology were the most important correlates. These results suggest that impulsivity is involved in initiating risk behaviors, but comorbid psychopathology and severity of alcohol dependence are more strongly correlated with the negative consequence of an accident occurring.

It is important to note that the main question from our study referred to risky behavior after drinking alcohol. According to Dom et al. (Dom et al., 2006), the level of impulsivity remains stable as a personality feature with practically no changes during alcohol intoxication, withdrawal or abstinence. However, results of other studies indicate that impulsivity may be treated as a state-related symptom affected by ethanol use (or other psychoactive substances). Several studies reported increased impulsivity during intoxication with alcohol (Dougherty et al., 2000; Field et al., 2010; Guillot et al., 2010; Olmstead et al., 2006; Wilhelm et al., 2007), with an observed decrease during abstinence (Wilhelm et al., 2007). Results of the stop-signal task, an objective measure of behavioral impulsivity reflecting real-time brain activity, were associated with neither risky behaviors, nor accidents following alcohol use. We hypothesize that the same task would give different results when performed in the same group of patients but after drinking alcohol.

Interestingly, results of some studies suggest that drinking alcohol enhances impulsive behaviors only in particular groups of patients, such as individuals with working memory dysfunction (Finn et al., 1999) or those who are impulsive but do not reveal impulsive behaviors until an imbalance between neural systems that control decision making appears (Dougherty et al., 2000). According to Noel et al. (2010) and Bechara (2005), ethanol and other substances may trigger impulsive actions by inhibiting the regulatory prefrontal cortex function (Bechara, 2005; Noel et al., 2010). Our results are consistent with this hypothesis: individuals endorsing more general characteristics of impulsivity in the BIS questionnaire appeared to behave in a more risky way after alcohol drinking. This provides some kind of "evidence based" perspective of the Italian proverb "*In vino veritas*" suggesting that impulsive (risky) behaviors appear after alcohol drinking in individuals who are impulsive "from character". However, this interpretation is limited by the lack of questions regarding risky behaviors when not drinking.

As would be expected, the mean BIS scores in our study were higher than in healthy controls in other studies (Lewis et al., 2009; Strakowski et al., 2010; Swann et al., 2009). In the general population (Chamorro et al., 2012) male gender and younger age were associated with more risky behaviors after drinking. Similarly in our study, male patients were more likely to behave in a risky way and to have an accident after drinking alcohol than female subjects, but in contrast to the general population we observed no association between age and frequency of accidents. In our study, older patients were alcohol dependent for a longer period of time, which may contribute to deficiency in cognitive functions (Oscar-Berman and Marinkovic, 2007) and increase the probability of experiencing an accident after drinking alcohol.

Our results have to be interpreted in the context of other limitations as well. One limitation of the study is the use of the very general term, "risky behavior", in the key question from the questionnaire, which may be differently understood by different patients. The

questionnaire was also self-administered and the results were not verified in an objective way. In addition, the study group may not be representative most individuals with alcohol dependence. The group of alcohol-dependent individuals entering residential treatment programs may be perceived as a group of subjects with high impulsivity. Impulsivity is a predictor of poor treatment outcomes in alcohol dependence (Lejuez et al., 2010), and more impulsive individuals experience more severe consequences of alcohol drinking. This selection bias might have influenced the significance of measuring impulsivity in the analyzed group. It has to be emphasized that our results apply only to alcohol-dependent patients and cannot be generalized to other groups. These results involve only correlation, not causation. We cannot conclude that impulsivity caused the risky behaviors or accidents reported by this sample. Finally, lack of validation for individual items derived from the SIP and MAST is another important limitation of the study.

5. Conclusion

In conclusion, our results show that risky behaviors and accidents are common in the group of alcohol-dependent patients. High levels of impulsivity may be considered as an important predictor of starting a risky activity, but comorbid psychopathology and severity of alcohol dependence that contribute mostly to negative consequences such as accidents. These results are interesting from cognitive perspective, but may also facilitate the important and difficult clinical task of identifying patients who are at highest risk of real consequences of a risky decision.

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Highlights

- We investigate the level of impulsivity in alcohol dependent patients.
- We analyze predictors of accidents and risky behaviors separately.
- Impulsivity is the most important predictor of risky behaviors after drinking.
- Impulsivity does not significantly predict a history of accidents.
- Global psychopathology and severity of alcohol dependence predict accidents.

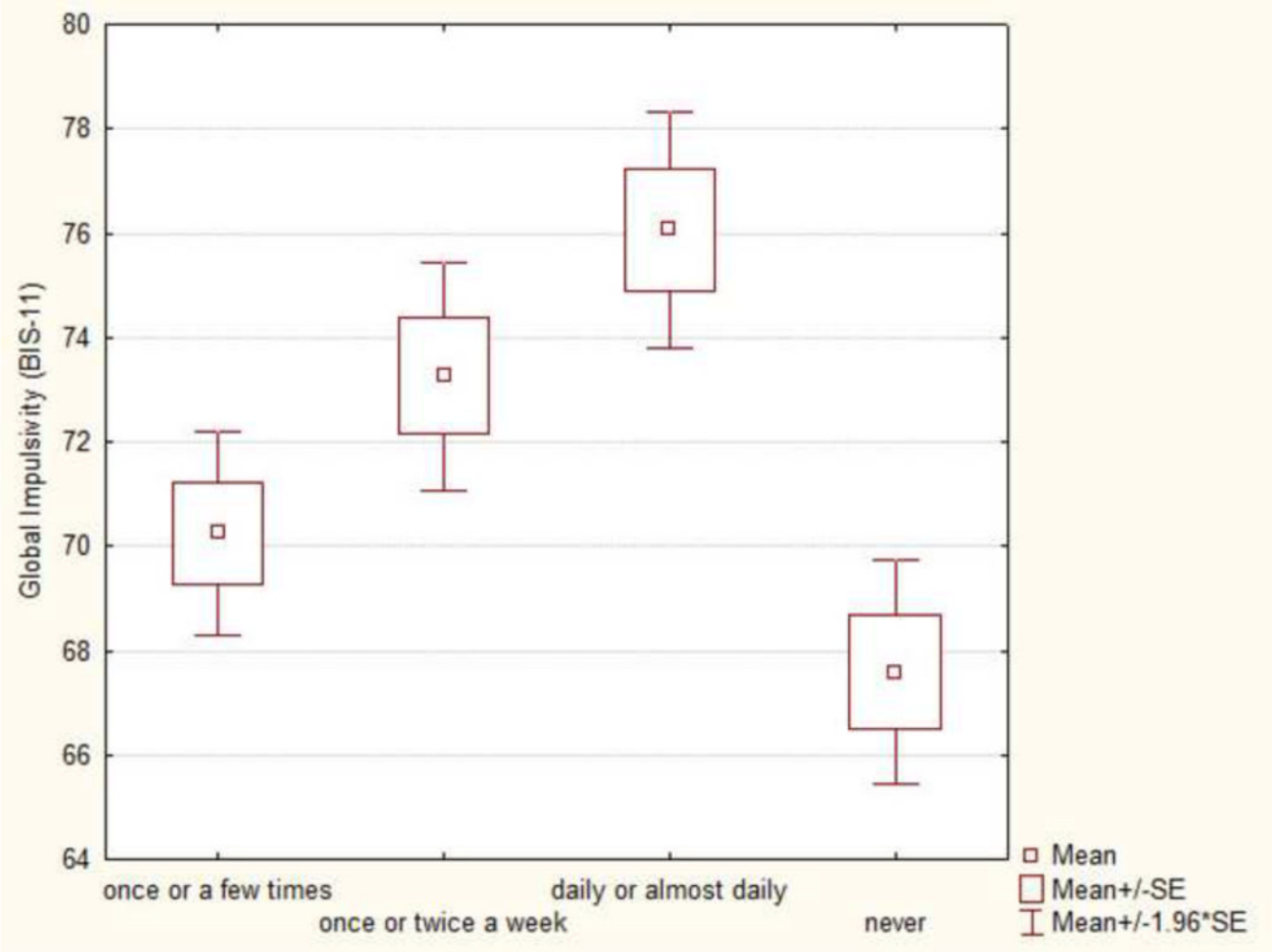

Figure 1.

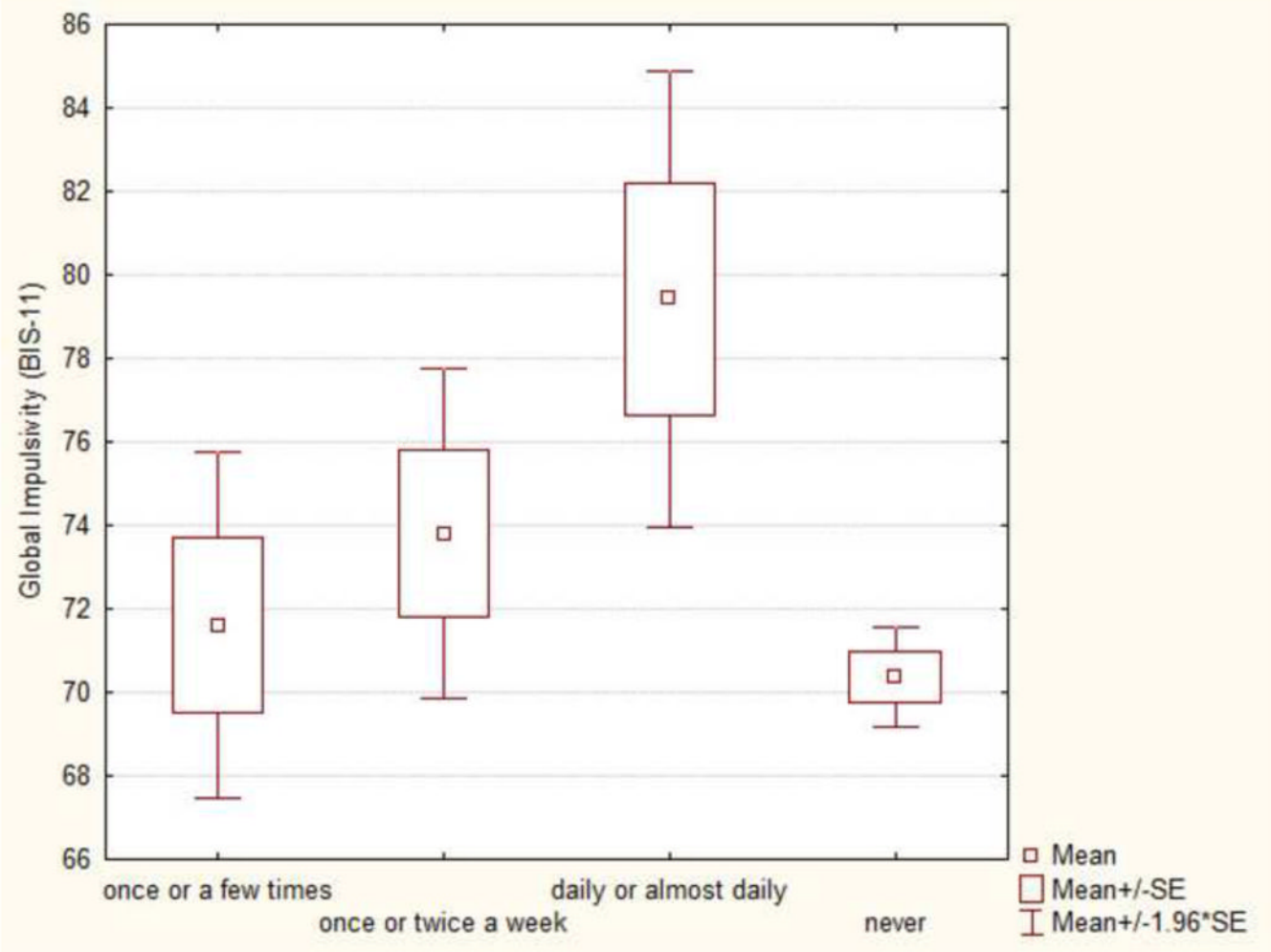

Figure 2.

Table 1

Association between accidents, risky behaviors and different types of impulsivity in alcohol-dependent patients (comparison of „p" values).

	Global impulsivity (BIS)	Attention impulsivity (BIS)	Motor impulsivity (BIS)	Non-planning impulsivity (BIS)
Risky behavior after drinking alcohol	**0.000001**	**0.000002**	**0.0018**	**0.000075**
Accident after alcohol	**0.00067**	**0.0076**	**0.0014**	**0.0497**
Driving after alcohol use	**0.013**	0.223	0.051	**0.009**
"Sober room" or being arrested after alcohol drinking	**0.0014**	**0.038**	**0.0034**	**0.0093**

BIS – Barratt Impulsiveness Scale

p-values < 0.05 were bolded

Table 2

Multivariate model of linear regression for the prediction of risky behavior after alcohol drinking.

Predictive factor	Beta coefficient	p
Global impulsivity (BIS)	**0.169**	**0.014**
Severity of alcohol dependence (MAST)	**0.146**	**0.026**
Age	**−0.120**	**0.046**
Gender	0.067	0.287
History of recent drug use	0.066	0.275
Severity of psychopathology (GSI)	0.020	0.764
Behavioral impulsivity (StopRT)	0.004	0.951

BIS – Barratt Impulsiveness Scale, MAST - Michigan Alcoholism Screening Test, StopRT – stop reaction time, GSI – General Severity Index from the Brief Symptom Inventory

p-values < 0.05 were bolded

Model:

$R = 0.34$; $R^2 = 0.11$; cor $R^2 = 0.09$

$F = 4.80$; $df = 7.26$; $p = 0.000042$

Table 3

Multivariate model of linear regression for the prediction of accident after alcohol use.

Predictive factor	Beta coefficient	p
Severity of alcohol dependence (MAST)	**0.200**	**0.002**
Gender	**0.157**	**0.012**
Severity of psychopathology (GSI)	**0.150**	**0.022**
Behavioral impulsivity (StopRT)	0.09	0.122
Age	0.09	0.147
History of recent drug use	0.06	0.298
Global impulsivity (BIS)	0.051	0.443

BIS – Barratt Impulsiveness Scale, MAST - Michigan Alcoholism Screening Test, StopRT – stop reaction time

GSI – General Severity Index from the Brief Symptom Inventory

p-values < 0.05 were bolded

Model:

$R = 0.38$; $R^2 = 0.15$; cor $R^2 = 0.12$

$F = 6.37$; $df = 7.26$; $p = 0.00001$