ECRONICON OPEN ACCESS

EC NEUROLOGY
Research Article

Attention Bias in Current Heroin Abusers and Patients under Methadone Treatment

Mohammad Zare-Neyestanak*

Department of Psychology, Naein Branch, Islamic Azad University, Naein, Iran

***Corresponding Author:** Mohammad Zare-Neyestanak, Department of Psychology, Naein Branch, Islamic Azad University, Naein, Iran.

Received: July 16, 2019; **Published:** September 09, 2019

Abstract

The aim of the present study is to compare attention bias in heroin abusers, patient under methadone treatment and the control group in Isfahan, Iran. This is a casual-analytical study. Convenience sampling was used in the first two groups, and non-probability sampling in the control group. Study population consisted of methadone and heroin users in Isfahan, Iran, who attended inpatient and outpatient addiction rehabilitation facilities, psychiatric clinics and other health care centers in Isfahan in October and November of 2015. Overall, 120 subjects were recruited (40 in each group) according to DSM-5 criteria for drug abuse or dependence and were evaluated using the Stroop Color and Word Test (SCWT). Analysis of variance showed that function in the control group was significantly better than in heroin and Methadone users ($p < 0.05$), but there was no statistically significant difference between heroin and methadone users ($p > 0.05$). Methadone and heroin use results in altered brain structure and function, especially in frontal and prefrontal areas, and leads to impaired neuropsychological function such as attention bias in these areas.

Keywords: *Attention Bias; Methadone; Heroin; Executive Functions*

Introduction

Some synthetic or semi-synthetic drugs can have depressant, stimulant, and hallucinogen effects on the central nervous system. These include a wide range of products and are collectively referred to as psychotropics. These substances can impair many physiological and neuropsychological functions. Abuse-related disorders may result from the long-term consumption of alcohol, opiates, cannabis, amphetamines, and cocaine, among others [1].

Heroin is derived from morphine and is two to three times more potent, with stronger stimulant effects. It causes serious injuries in upper brain structures and results in impaired psychological and neuropsychological function [2]. Globus pallidus is one of the brain's basal ganglia, which coordinates intentional movement, unintentional movement, and cognitive functions [3,4]. Heroin impairs cognitive functions through injuring Globus pallidus [5]. Heroin also damages recent memory, attention, reaction inhibition and mental flexibility [6-8]. Researchers have shown that heroin abusers score lower in tests evaluating IQ, concentration, memory and psychomotor coordination. Some researchers [2,9] emphasis the effect of heroin on cognitive and behavioral disorders.

Methadone is a synthetic opiate, which causes euphoria, inhibits pain, and demonstrate effects similar to other pseudomorphines. Unlike heroin, stable doses of methadone do not cause euphoria. Consequently, methadone maintenance therapy is one of the important and critical methods used to decrease injection and illicit drug use and to reduce harm. Long-term treatment also reduces recurrence or resort to more harmful substances in the patient. Treatment generally results in improved psychological and physical health and social

function, which may provide a chance for the patient to return to work [10]. Methadone shows some neuropsychological and cognitive side effects [11]. When methadone users were evaluated for brain and cognitive injuries, it was revealed that they performed poorer in neuropsychological tasks compared to the control group. Cognitive evaluation in opiate dependent shows that information processing in opiate-dependent people is fraught with attention bias. This could have an important role in continuation and recurrence of various normal and abnormal behaviors such as drug abuse [12]. Bias is defined as any kind of organized lateral dominance of the priorities in decision-making. It has been proposed that people with opiate dependency have a higher probability of selecting the information on desirable stimulants [13].

Attention bias is a phenomenon in which- despite all the efforts of a person to ignore a stimulus- all their attention is directed to it [14]. It plays an important role in many psychological pathologies. For instance, when attention bias is focused on opiates, it can initiate processes resulting in substance use. Many researchers have highlighted the role of attention bias in the failure to control drug-abuse related behaviors [15,16]. Some other researchers emphasize the role of psychiatric disorders and consider excitement a critical element with important but ambiguous effects on bias.

Methadone is considered a less harmful substitute for opiates, especially heroin, and is extensively used in addiction treatment centers for detoxification and maintenance. The evidence on the undesirable effects of methadone is controversial and further research is needed to fully elucidate its effects. The present study aims to compare attention bias scores in drug abusers, patients under methadone maintenance therapy and control group using the Stroop Color and Word Test (SCWT).

Materials and Methods

Study design

This is a causal-comparative study to evaluate function in heroin abusers and patients under methadone treatment in comparison to the normal control group. The study population consisted of methadone and heroin users in Isfahan, Iran, who attended inpatient and outpatient addiction rehabilitation facilities, psychiatric clinics, and other health care centers in Isfahan, Iran in October and November of 2015.

Sampling

Based on the causal-comparative design of the present study, we selected 40 cases for each group. Samples were recruited according to non-probabilistic method. Sampling began with recruiting 40 abusers and 40 patients under methadone maintenance treatment with convenience sampling. Afterwards, the normal control group was matched to the previously selected cases in age and sex. General inclusion criteria were: being male, age between 20 and 40 years, and having successfully finished primary school. Additional inclusion criteria in the heroin abuser group were: meeting DSM-5criteria for dependence, minimum one year history of heroin use, and duration of discontinuation between 1 to 3 months. Additional inclusion criteria in the methadone group were: being on methadone therapy for at least 6 months, and not consuming any other potentially addictive drugs. Participants in the control group were recruited from the family members and companions of abusers- provided they had no life time history of any drug abuse. Exclusion criteria were: history of head trauma followed by loss of consciousness, temporal lobe epilepsy, major disorders according to DSM-5, and current use of other drugs which might affect central nervous system. All three groups underwent psychiatric interview.

Instruments

A demographic questionnaire was used to gather information on age, sex, education, marital status and occupation. Computerized version of the Stroop Color and Word Test (SCWT) was performed for all subjects. The test consists of two steps. Step 1 consists of naming colors, where the examinee is required to indicate the color of the indicated shape in a colored collection. For instance, participants are asked to name the color of a circle, which is shown in a four color schema of red, blue, green and yellow. The aim of this step is to familiarize the subject with colors and the keyboard and it does not affect the final score. In the second step, which is the main part of

Stroop test, the examinee is shown 48 color-congruent and 48 color-incongruent words, consisting of red, blue, green and yellow. The task is to correctly identify the color despite the meaning of the words. Each stimulus is offered for 2 seconds with a gap of 800 milliseconds between them. Researchers believe that the color-word task (the second step) measures mental flexibility, interference and response inhibition. The inference score is calculated by subtracting the correct incongruent score from the correct congruent score. Many experts believe that the test has good construct validity in measuring executive functions such as selective attention, divided attention, response inhibition, flexibility and frontal lobe dysfunction.

Internal consistency of the test was reported 0.81. Validity of the test was reported between 0.72 to 0.85 The test-retest reliability was 0.89 and the Cronbach's alpha for each test was reported 0.82 in an Iranian sample.

Methods

After obtaining the permission of the heads of the clinics and inpatient rehabilitation centers, subjects were recruited based on inclusion and exclusion criteria. Participants were offered complete oral and written descriptions of the aims and process of the study and were assured of the confidentiality of their information and their right to leave the study at any desired point. Those who consented were evaluated for inclusion and exclusion criteria and then received detailed explanation on test steps. Computerized version of the Stroop test for attention bias was performed for all subjects. Scores were calculated and results were analyzed using SPSS version 22. Descriptive analyses- such as frequencies, mean, percent, standard error; and inferential statistical methods- such as one way ANOVA were performed.

Results

As shown in table 1, most of the participants in the control group (14 people, 35%) and heroin abusers (13 people, 32.5%) were between 26 and 30 years old. In the under methadone treatment group, 11 participants (27.5%) were between 21 and 25 years old.

	Control group		Under Methadone treatment group		Heroin Abusers	
Age Group	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
21 - 25	11	27.5	11	27.5	9	22.5
26 - 30	14	35.0	10	25.0	13	32.5
31 - 35	7	17.5	9	22.5	7	17.5
35 - 40	8	20.0	10	25.0	11	27.5
Total	40	100.0	40	100.0	40	100.0

Table 1: *Age distribution of participants in 3 groups.*

As shown in table 2, participants with high school diploma were more prevalent in control and methadone treatment groups (12 participants in each group, 27.5%). In the heroin abuser group, those with primary school education and some high school education were more prevalent (11 in each category, 27.5%). In the heroin abuser group, there were no participants with university educations.

	Control group		Under Methadone treatment group		Heroin Abusers	
Education	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Primary School	5	12.5	8	20.0	11	27.5
High school	16	40.0	18	45.0	21	52.5
High School Diploma	12	30.0	12	30.0	8	20.0
Associate's Degree	5	12.5	1	2.5	0	0
Bachelor's Degree	2	5.0	1	2.5	0	0
Total	40	100.0	40	100.0	40	100.0

Table 2: *Education distribution of the participant in the three groups.*

Table 3 shows participants' occupational status. Most of the control group worked in the private sector, followed by unemployed and public sector workers But in heroin and methadone groups the unemployed are more frequent, followed by private sector workers. None of the participants in the heroin group declared a public-sector employment.

	Control group		Under Methadone treatment group		Heroin Abusers	
Occupation	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Public Sector	7	17.5	3	7.5	0	0
Private Sector	24	60.0	18	45.0	15	37.5
Unemployed	9	22.5	19	47.5	25	62.5
Total	40	100.0	40	100.0	40	100.0

Table 3: *Occupational status of the participants in the three groups.*

Most of the participants in control and methadone groups were married and none of the participants in the control group were divorced. In the heroin group, singles were more prevalent (Table 4).

	Control group		Under Methadone treatment group		Heroin Abusers	
Marital Status	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Single	18	45.0	14	35.0	18	45.0
Married	22	55.0	23	57.5	17	42.5
Divorced	0	0	3	7.5	5	12.5
Total	40	100.0	40	100.0	40	100.0

Table 4: *Marital status of the participants in the three groups.*

Because of the effect of age and education on the target variables of this study (attention bias, executive functions and implicit memory), we aimed to match the groups on demographic characteristics during the sampling process. We compared distribution of these variables between the groups using two-sided χ^2 test. This statistical analysis yielded P values greater than 0.05 ($\chi^2 = 6.39$, P value: 0.17) ($\chi^2 = 1.79$, P value: 0.93), so we can infer that the groups are not significantly different in respect to these variables and the samples are appropriately matched.

As shown in table 5, the highest and lowest maximum matched and mismatched reaction times were observed in heroin and control group respectively. The same pattern was also observed in the number of errors.

Mean		Control group		Under Methadone treatment group		Heroin Abusers	
		Standard error	**Mean**	**Standard error**	**Mean**	**Standard error**	
Reaction Time	Congruent	979.45	106.33	1047.60	114.08	1219.65	157.13
	Incongruent	1010.97	96.98	1093.55	113.84	1276.07	130.44
Error Count	Congruent	0.43	0.25	1.02	0.92	1.71	1.12
	Incongruent	0.53	0.53	1.97	1.80	4.54	3.97

Table 5: *Descriptive characteristics of the participants in Stroop test in three study groups.*

Table 6 shows that calculated F statistics for all Stroop scores are lower than the critical point and there is a significant difference between the groups in congruent and incongruent reaction times and error counts. These findings are in agreement with the study hypothesis postulating a difference between heroin abusers and those under methadone maintenance therapy in attention bias. We further used Tukey's post-hoc test for pair-wise comparisons among groups.

Stroop test		Source of Variation	Sum of squares	Degrees of freedom	Mean squares	F	P value
Reaction time	Congruent	Between groups	1225888.86	2	612944.43	37.51	0.001
		Within groups	1911658.60	117	16338.96	-	-
		total	3137547.46	119	-	-	-
	Incongruent	Between groups	1472160.21	2	736080.10	56.07	0.001
		Within groups	1535911.65	117	13127.45	-	-
		total	3008071.86	119	-	-	-
Error Count	Congruent	Between groups	16.18	2	8.40	6.04	0.003
		Within groups	162.65	117	1.39	-	-
		total	179.46	119	-	-	-
	Incongruent	Between groups	263.75	2	131.87	16.36	0.001
		Within groups	943.05	117	8.06	-	-
		total	1206.80	119	-	-	-

Table 6: *Results of analysis of variance of Stroop scores in groups.*

After ascertaining the existence of significant difference between the groups, Tukey's post-hoc test was performed to compare the groups pair-wise with each other. Results showed that each of the three groups was statistically different from the other two based on the congruent reaction time, incongruent reaction time and congruent error count (P values < 0.05). The best and worst performance were observed in control and heroin groups, respectively.

		Reaction time		Error count	
		Congruent	Incongruent	Congruent	Incongruent
Control	Methadone	- 68.15*	-82.57*	- 0.67*	- 1.62*
	Heroin	- 240.20*	-265.10*	- 0.87*	- 3.62*
Methadone	Control	68.15*	82.57*	0.67*	1.62*
	Heroin	- 172.05*	- 182.52*	- 0.20	- 2.00*
Heroin	Control	240.20*	265.10*	0.87*	3.62*
	Methadone	172.05*	182.52*	0.20	2.00*

Table 7: *Results of Tukey's post-hoc test on Stroop scores among the three groups.*

As it can be seen in the table 7, the incongruent error count is statistically different in the control group compared to heroin and methadone groups ($p < 0.05$), however, the difference between the heroin and methadone groups is not significant.

Discussion

The present study was performed to compare attention bias in heroin abusers, patients under methadone maintenance therapy, and normal control subjects in Isfahan, Iran. Analysis of variance on the results of Stroop test showed that attention bias is significantly differ-

ent among the three groups; and post-hoc test demonstrated significant differences between the control group and the other two groups. There was no significant difference between methadone and heroin groups. The mean score of attention bias in these two groups was significantly lower than the control group. Results of this study are in agreement with those reported earlier by Rabinson and Berridge [17], Fadardi and Cox [18], Simon., *et al*. [19] and Tiffany [13].

Our study showed that using opiate and methadone both increase the error count and the response time compared to the normal control group. Furthermore, heroin and methadone users show a significant difference in error count in Stroop test. Simon., *et al*. [19] argue that the main reason for attention bias in heroin users is classic conditioning, which results in staying in craving cycle through attention and processing of environmental information relevant to abuse while ignoring other information. According to phenomenological approach, mutual excitatory relationship between biologic and environmental factors result in continued addictive behaviors. Field and Cox [20] mention that craving has an important determining effect on continued substance use and can be the first-line target in treatment. Other factors that could affect attention bias include hypervigilance for substance related stimuli, inability to balance attentional processes, amount of substance abused, and personal characteristics. Attention bias might act through three paths in drug abuse and recurrence. First, persistent addictive behaviors might reflect the presence of drug-related signs in the environment. These automatic processes tend to analyze such signs prior to others. Second, in the presence of drug-related signs and their automatic analysis distracting the attention from them would be difficult. Third, limitation of attention capacity and automatic concentration on drug-related signs results in impaired analysis of other environmental signs. Research shows that bias in favor of drug-related stimuli can result in compulsive drug use. Similarly, prolonged reaction time in the presence of drug related signs during attention tests might reflect drug craving.

All participants in our study were male and the results might not be generalizable to females. Another limitation of the study was variation in the duration of addiction of the participants, although we tried to minimize this by setting a minimum of one-year duration of addiction for inclusion in the study. Patient under methadone maintenance therapy had different doses of methadone. Evaluations were performed in different locations and it was not feasible to provide identical circumstances.

Findings of the present study suggest that close interdisciplinary cooperation of medical and psychiatric experts with psychologists can provide a better chance for recovery and rehabilitation to drug-dependent patients.

Conclusion

Generally, substance abusers are often evaluated with medical and psychological tests during treatment and afterwards, and their respective disorders are identified and cared for, while cognitive disorders are frequently missed. Such disorders can have a substantial effect on patients' daily life and function, such as lack of correct decision making processes, impulsivity, and lack of inhibition against negative stimuli, to name a few, making life very difficult. Thus, addressing these problems and providing protocols for rehabilitation is necessary and useful.

Acknowledgements

The authors thank the patients who participate in this study.

Conflict of Interest

The authors declare no conflict of interest.

Bibliography

1. American Psychiatric Association. "Diagnostic and statistical manual of mental disorders". 5th edition. Arlington: American Psychiatric Association (2013).

2. Lackovic Z. "Psychoactive drugs and neuroplasticity". *Psychiatria Danubina* 19.3 (2007): 2020-2205.

3. Laplane D., *et al*. "Obsessive-compulsive and other behavioural changes with bilateral basal ganglia lesions, A neuropsychological, magnetic resonance imaging and positron tomography study". *Brain* 112.3 (1989): 699-725.

4. Tolomeo S., *et al*. "Compulsivity in Opioid dependence". *Progress in Neuro-Psychopharmacology and Biological Psychiatry* 81 (2018): 333-339.

5. Davis PE., *et al*. "Neuropsychological deficits and opiate abuse". *Drug and Alcohol Dependence* 67.1 (2002): 105-108.

6. Fishbein DH., *et al*. "Neurocognitive characterizations of Russian heroin addicts without a significant history of other drug use". *Drug and Alcohol Dependence* 90.1 (2007): 25-38.

7. Yan WS., *et al*. "Working memory and affective decision-making in addiction: a neurocognitive comparison between heroin addicts, pathological gamblers and healthy controls". *Drug and Alcohol Dependence* 134.1 (2014): 194-200.

8. Segalà L., *et al*. "Childhood Symptoms of ADHD and Impulsivity in Abstinent Heroin Users". *Journal of Dual Diagnosis* 11.3-4 (2015): 174-178.

9. Severtson SG., *et al*. "Patterns of cognitive impairments among heroin and cocaine users: the association with self-reported learning disabilities and infectious disease". *Journal of Learning Disabilities* 45.2 (2012): 139-150.

10. Specka M., *et al*. "Cognitive-motor performance of methadone maintained patients". *European Addiction Research* 6.1 (2000): 8-19.

11. Darke S., *et al*. "Cognitive impairment among methadone maintenance patients". *Addiction* 95.5 (2000): 687-695.

12. Wang GY., *et al*. "Neuropsychological performance of methadone-maintained opiate users". *Journal of Psychopharmacology* 28.8 (2014): 789-799.

13. Tiffany ST. "Cognitive concepts of craving". *Alcohol Research Health* 23.3 (1999): 215-224.

14. Williams JM., *et al*. "The emotional Stroop task and psychopathology". *Psychological Bulletin* 120.1 (1996): 3-24.

15. Ziaee SS., *et al*. "Effects of attention control training on drug abusers' attention bias and treatment outcome". *Journal of Consulting and Clinical Psychology* 84.10 (2016): 861-873.

16. Soleimannejad M., *et al*. "Evaluation of Attention Bias in Morphine and Methamphetamine Abusers towards Emotional Scenes during Early Abstinence: An Eye-Tracking Study". *Basic Clinical Neuroscience* 6.4 (2015): 223-230.

17. Robinson TE., *et al*. "The neural basis of drug craving: An incentive-sensitization theory of addiction". *Brain Research Review* 18.3 (1993): 247-291.

18. Fadardi JS., *et al*. "Reversing the sequence: Reducing alcohol consumption by overcoming alcohol attentional bias". *Drug and Alcohol Dependence* 101.3 (2009): 137-145.

19. Simon SL., *et al*. "Cognitive impairment in individuals currently using methamphetamine". *The American Journal on Addiction* 9.3 (2000): 222-237.

20. Field M., *et al*. "Attention bias in addictive behaviors: a review of its development, causes, and consequences". *Drug and Alcohol Dependence* 97.1-2 (2008): 1-20.

Volume 11 Issue 10 October 2019