



Journal of Fundamentals
of Mental Health



Mashhad University
of Medical Sciences



Psychiatry and Behavioral Sciences
Research Center

Original Article

The role of cognitive impairment in risky sexual behavior of man with chronic methamphetamine abuse

*Hashem Jebraeili¹; Alireza Moradi²; Mojtaba Habibi³; Tannaz Seydi⁴

¹Assistant professor, Ph.D. in health psychology, Department of Psychology, School of Social and Educational Sciences, Razi University, Kermanshah, Iran

²Professor, Ph.D. in clinical psychology, Department of Clinical Psychology, Kharazmi University, Tehran, Iran

³Assistant professor, Ph.D. in health psychology, Department of Health Psychology, School of Behavioral Sciences and Mental Health (Tehran Institute of Psychiatry), Iran University of Medical Sciences, Tehran, Iran

⁴MA. student of general psychology, Razi University, Kermanshah, Iran

Abstract

Introduction: The immediate effects of methamphetamine abuse on risky sexual behavior are well known, but there is little information on the effects of chronic methamphetamine abuse and its cognitive impairments on risky sexual behavior, so this study aimed to investigating the role of cognitive dysfunctions on risky sexual behavior of man with chronic methamphetamine abuse.

Materials and Methods: The present study is analytical cross-sectional. Statistical population consisted of all men with methamphetamine abuse who were resident in addiction treatment camps of Tehran city. From this population a sample included of 300 individuals was selected through convenient sampling and They were assessed through Trail Making Test, Rapid Visual Information Processing task, and risky sexual behavior questionnaire. Data were analyzed based on correlation tests and regression analysis using SPSS software.

Results: The findings showed that continuous attention ($r=-0.13$, $P<0.05$) and attention control ($r=0.17$, $P<0.01$) had significant correlation with risky sexual behavior. The regression equation used to predict risky sexual behavior on cognitive functions was significant ($F=6.16$, $P<0.01$). Continuous attention ($t=-2.58$, $P<0.05$) and attention control ($t=3.54$, $P<0.01$) had significant role in prediction of risky sexual behavior.

Conclusion: The findings revealed that cognitive impairment and risky sexual behavior are very common in chronic methamphetamine abuse and cognitive impairments are responsible for part of the risky sexual behavior in methamphetamine abusers.

Keywords: Cognitive flexibility, Continuous attention, Executive control, Methamphetamine abuse, Risky sexual behavior

Please cite this paper as:

Jebraeili H, Moradi A, Habibi M, Seydi T. The role of cognitive impairment in risky sexual behavior of man with chronic methamphetamine abuse. *Journal of Fundamentals of Mental Health* 2019 Nov-Dec; 21(6): 387-397.

*Corresponding Author: Department of Psychology, School of Social and Educational Sciences, Razi University, Kermanshah, Iran

h.jebraeili@yahoo.com

Received: May. 14, 2018

Accepted: Sep. 21, 2019

Introduction

Risky sexual behavior that generally defined as sexual activity that increase the risk of HIV or other relative illnesses (1), is one of the serious challenges of general health that most of the countries are confronted everyday more than one million people in the world are involved in sexual infection (2), and in U.S.A near 19 million new sexual diseases are reported during a year that their direct medical treatment cost is \$17 billiard for hygienic discipline (3). Although risky sexual behavior can be observed between all the groups, substance abusers are those groups that can be affected by risk of risky sexual behavior (4). Between substance abusers those group that use stimulants like methamphetamine are risky groups and we can say that they affected by risky sexual behavior directly.

Methamphetamine that is strongly addictive has high abuse degree and is second intensive substance in the world (6). This substance that is motive for central nervous system, causes high level releasing of dopamine and in this way increase temper (7), and create friskiness, increasing of sexual excitement, appetite deduction, high level of energy and long sexual exciter (8). Methamphetamine is also knows as sexual exciter, depressor of falconry in sexual situation, and increase in sexual eroticism (9). Using of methamphetamine is related with worse sexual experiment searching, having unprotected sexual venereal, having more sexual partner, and having sexual association with abuser of mainline and positive HIV and having sexual activity instead of substance or money (1,5,10).

Although reported relation between using methamphetamine and sexual behavior is related to abuse, but it seemed that long and chronic abuse of methamphetamine changing brain structurally and operationally

because of it in risky sexual behavior can be affecting (11).

In reality studies show that repeated use comes with methamphetamine with neurotoxic effects on dopaminergic systems and serotonergic and also resulted in serious impairments in nervous system or cell body (12-15). Although its exact mechanism is not clear, plenty of evidence predicated that release of high level of cytoplasmic dopamine because of using methamphetamine resulted in accumulation of reactive oxygen species that causes oxidative stress on nervous cells (16). Studies by positron emission tomography (PET) and magnetic resonance imaging (MRI) also shows static nervous impairments because of methamphetamine abuse (17).

These impairments can directly effect on cerebral structures that are active in cognitive process and probably resulted in impairments in cognitive abilities in chronic users of methamphetamine. Although there is no agreement about kind of cognitive disorders in chronic abuser of methamphetamine, most of the new views on disordering in forbidding or executive control in repeated use of drugs (18) that is including response prevention, working memory, attention, problem solving, set shifting or cognitive flexibility and the other proceeds (19,20). Between this factors especially response inhibitions, attention, and cognitive flexibility are related to addiction disorders (21,22), and evidence showed response inhibition (23), attention problem (24), and cognitive inflexibility (25) was related to methamphetamine abusing. So with due to this point that risky sexual behavior is kind of discarder in response inhibition (26), risky sexual behavior is possible between chronic methamphetamine abuse and we can say that it is because of disorder in activities related

to executive control. Then due to importance of study of risky sexual behaviors in risky population and limitation of information about the reason of these behaviors between consumers of methamphetamine this study aimed to study the role of disorder in cognitive functions (attention, response inhibition and cognitive flexibility) in risky sexual behavior between chronic consumers of methamphetamine.

Materials and Methods

The present study is analytic-cross-sectional and is belong to correlational research in terms of gathering method and data analysis. Statistical population is consisted of all methamphetamine abuser men who were lived in addiction treatment camps of the Tehran City. With due to about 100 middle time center for addiction treatment in Tehran and presence of about 20 abuser of methamphetamine in every of these centers, statistical population were about 2000 people. According to this population and using of Cochran formula (27) with %5 level of error, the sample of research measured about 320 individuals, but at the end, data from 294 individuals were useable in final analysis. In this study we used convenience method of sampling and this research have been done on some people who were volunteer for participate in this study.

Doing present study was being done in such a way that after getting permission from Welfare Organization of Tehran and agreement of authorities from addiction treatment centers.

Inclusion criteria concluded methamphetamine abuse, being at least 18 years old, having at least elementary education certification, not using medication for psychiatry disorder treatment and agree to participate in this research.

Exclusion criteria included : not remember the alphabets that were necessary for one of

the tasks, being new case of the camp and not having stable state, and using methamphetamine just for one or two times. At first, questionnaires and then cognitive tasks have been run individually. In regard to considering ethical principles, in addition to obtaining informed consent of individuals, it explained for participants that there is no force for participating in research or continuing it, and in every step they can go out if they didn't like to continue. The research project with IR-IUMS.REC 139632079 code is confirmed by ethical committee of Iran University of medical sciences.

Research instrument

A) Rapid Visual Information Process (RVP): This task is one of the CANTAB (28) tests that developed for measuring sustained attention. Format of this test is in such a way that there is one white box in middle of screen that inside it there are numbers from 2-9 are showing with random order and 100 number per minute. It asked to participant to identify target number sequences (for example, 6-4-2 ,7-5-3 ,8-6-4). Whenever they saw numbers succession, they should answer by using bottom in the middle of screen as soon as possible. Test difficulty level changed according to this point that subjects at the same time observe one or three sequences of number as target. With all the CANTAB tests, validity of this test has been confirmed with study of clinical validity and factorial structure, and its reliability has been confirmed by testing internal consistency and test-retest reliability.

B) Mental System Assessment- Advanced Edition Assist (MeSA-AE Assist): This tool has been made based on trail making test. Trail making test at first was made as a part of army individual tests in 1944, and then in different fields like clinical and studios situations, it was used. Synergetic of

psychical measurement system by an examiner and with computer guide and timing program. The aim of this test is measure of overall executive control with measurement of sight attention control and cognitive flexibility. Total executive control quotient this test has meaningful role in capabilities related to total executive function of individual. Wider definition of executive function was hold as a combination of four higher order cognitive ability of attention control, conceptual flexibility, programming and verbal fluency that are necessary for behavior self-regulating and goal attainment. Scale of executive control quotient of this test has been made on composed measurement of two first important factor of executive function. These two components are known as attentional control and cognitive flexibility scores. Score of all three quotients are reporting by using of standard scores with mean \pm standard deviation equal to 100 ± 15 . Mental system assessment has been performed exactly by using of one examiner with the same formation, figuring, method and structure in trail making test. The only difference is that examiner in test execution timing, scoring and score interpretation is supported and this factor can help test validity.

Trail making test has been used widely because it is a valid tool for effects measurement and intensity of brain injury. Researchers demonstrated that the time of test increase in terms of the intensity of injury, and individuals' functions in every part of test predict they independent function level significantly. Shortly, the majority of studies supported the validity of this test in mustering impairments in general cognitive function, attention, and mental process speed, and the effectiveness and usefulness of this test have been confirmed in differentiate between different disorders

stem from cognitive function impairments (29). For studying the reliability of this task test-retest method has been used that reliability quotients for nonclinical samples in different studies for the first part was 0.46 to 0.94, and for second part was 0.44 to 0.95 (29).

C) Risky Sexual Behavior Questionnaire: This questionnaire is the HIV Risk-taking Behavior Scale (HRBS) that is designed for testing behaviors that increase probability of HIV transmission. Risky sexual behavior measured by questions about the numbers and kind of sexual partners and time and kind of unprotected sex relation that a person involved in it. The number of sexual partner has been hold as a factor that study the whole number of people who participant during a specified time have sexual relation. Sexual partners are classified in three groups: fixed partners like husband or fiancé, accidental partner like sexual relation with a person accidentally, and sexual relation with someone for getting money or substance. For finding more information about all kinds of sexual behavior that person involved in, questions about the number and different kind of sexual partner and question about duration of anal sex was traced. So, risky sexual relation is measured by 5 question that one of them is specified about the number of sexual partner, one is about the amount of having sex with any of different kind of sexual partners (three questions in total), and one of them is about anal sex during a given period of time. The whole of these questions demonstrate the involvement of person in risky sexual behavior in a specific period of time (30). Petry (31) in a study with the aim of testing psychometric attributes have tested it on 84 persons with substance abuse. In this study risky behavior related to HIV scale was used for assessment of risky behaviors during life, last month and last week. Cronbach's

alpha coefficient for 3 form of this measurement was 0.75 to 0.80. Test-retest reliability for long life was excellent (0.90). Furthermore, 44 individuals fulfilled weekly form of this test once a week for 4 weeks and monthly form in the end of same month. Reliability of gathered answers was good for monthly and weekly forms. Principal component analysis of items demonstrated that the scale measured two separate risk factors (sexual and injection behaviors) related to HIV. In the present study, Cronbach's alpha coefficient for five questions related to risky sexual behavior was about 0.71. The result of factor analysis with analysis of principal component and requesting of one factor for extraction demonstrated that extracted factor explained about 0.52 of the total variance and correlation of questions with gained factor were 0.41 to 0.84.

Data were analyzed by using of Pearson and Spearman correlation tests and regression analysis and SPSS software.

Results

Demographical information showed that subjects' mean age was 32.33 ± 7.70 years. The youngest subject was 18 year old and oldest subject was 54. There were 222 single people (75.5%) and 72 married people (24.5%). Six people (2%) had elementary school degree, 81 people (27.6%) had

middle school degree, 108 people (36.7%) had high school diploma, 51 people (17.13%) had associate degree, 36 people (12.2%) had bachelor degree, and 12 people (4.1%) had master degree or higher. Descriptive findings demonstrated that average of period that individual were without substance abuse was 58.20 ± 72.34 days. The average time for methamphetamine abuse was 12.51 ± 7.59 years.

Also, between study participants 20.4% of them lacked any sexual relation during the past six months earlier. Instead 79.6% (234 people) in this period of time have experienced sexual relation. Among person who have sexual behavior 48.7% (114 people) had sex with one partner, 23.1% (54 people) had sex with 2 to 3 partners, 7.7% (18 people) had sex with 4 to 6 partners, 2.6% (6 people) had sex with 7 to 10 partners, and 17.9% (42 people) had sex with more than 10 partners. During the time of having sexual behavior 95.3% had fixed partner, 48.5% had casual sexual partner, 19.2% had monetary sexual partner and 19.7% had anal sexual relation.

The means, standard deviations and correlation coefficients of variables presented in Table 1.

Table 1. The means, standard deviations and correlation coefficients of the variables

Variable	M	SD	1	2	3	4	5
1. Continues attention	86.12	5.51					
2. Attention control	73.59	21.07	0.24**				
3. Cognitive flexibility	58.37	27.34	0.40**	0.52**			
4. Executive control	53.81	27.32	0.38**	0.67**	0.95**		
5. Risky sexual behavior	6.11	5.31	-0.13*	0.17**	0.01	0.06	
-The number of sexual partner	-	-	-0.04	0.17**	0.11	0.17**	0.88**

- Unsafe sex with fixed sexual partner	-	-	0.16**	0.10	0.10	0.12*	0.70**
- Unsafe sex with casual sexual partner	-	-	-0.12*	0.13*	-0.03	0.04	0.70**
- Unsafe sex with monetary sexual partner	-	-	-0.03	-0.04	-0.12*	-0.06	0.44**
- Anal sex	-	-	0.01	0.12*	-0.08	-0.03	0.55**

*P<0.05 **P<0.01

As the finding demonstrate continues attention has biggest mean (86.12) and risky sexual behavior has smallest mean (6.11). In order to study the relation between variables Spearman and Pearson correlation tests were used. Results showed that risky sexual behavior with continues attention had significant negative relation (r=-0.13, P<0.05), and with attention control had significant positive relation (r=0.17, P<0.01). Results of Spearman test for study the relationship between subscales of risky sexual behavior and cognitive functions demonstrate that continues attention (r=-

0.16, P<0.01) and executive control (r=0.12, P<0.05) had the greatest meaningful correlation with unsafe sexual relation with fixed sexual partner. Attention control had the greatest significant relation with unsafe sexual relation with casual sexual partner (r=0.13, P<0.05), and cognitive flexibility had the greatest significant relation with unsafe sexual relation with monetary sexual partner (r=-0.12, P<0.05).

After testing correlation coefficients between variables, regression analysis used for exact test of cognitive dysfunction role in risky sexual behavior of chronic methamphetamine abusers. The results of regression analysis presented in Table 2.

Table 2. Summary of regression analysis for prediction risky sexual behavior on cognitive function

Dependent Variable	Predictive variable	Beta	T	P	R	R ²	F	P
Risky sexual behavior	(Constant)	-	3.14	0.002	0.25	0.06	6.16	0.001
	Continues attention	-0.16	-2.57	0.011				
	Attention control	0.24	3.54	0.001				
	Cognitive flexibility	-0.05	-0.76	0.451				

Independent t-test results for depression subscale The result demonstrate that regression equation that was used for prediction of risky sexual behavior on cognitive function is significant (F=6.16, P<0.01). Among cognitive dysfunction, continues attention (t=-2.58, P<0.05) and attention control

(t=3.54, P<0.01) had significant role in prediction of risky sexual behavior and did predicate about six percent of total variance of risky sexual behavior in chronic methamphetamine abusers.

Discussion

Descriptive findings of the present study demonstrated that the amount of risky sexual behavior and cognitive dysfunctions is completely high between chronic methamphetamine abusers. Findings showed that 79.6% of participants in 6 months before entering to the camp had experienced special kind of sexual relation. Among them

23.1% had sexual relation with 2 to 3 partners, 7.7% had sexual relation with 4 to 6, 2.6% had sexual relation with 7 to 10 and 17.19% had sexual relation with more than 10 partners. Also, among those who had sexual relation 48.5% had casual sexual partner, 19.2% had monetary sexual partner and 9.7% had anal sex. Among these individuals also 43.3% of them didn't use condom at the time of sexual relation with casual sexual partner and 20% of them didn't use condom at the time of sexual relation with monetary sexual partner.

This finding is in company with different studies (32-34) that explain about the prevalence of sexual behaviors among methamphetamine abusers. Meade et al. (32) in a study with the aim of assess the relation between sexual behavior and methamphetamine abuse on 3328 people find out that using methamphetamine is related to probability of engagement in risky sexual behavior and abusers are exposed to HIV because of involvement in risky sexual behaviors. Fernández et al. (34) also in a study found that there is direct relation between risky sexual behavior and using methamphetamine and they demonstrate that meth abusers sexual behaviors are unprotected. But these researches didn't specify that what is the reason and effective mechanisms of abusing methamphetamine on risky sexual behavior. In contrast, Holder et al. (33) conducted a animal study with this assumption that

methamphetamine abuse increase sexual willingness and is related to involvement in risky sexual behavior. They studied the effects of meth abuse on sexual behavior of female mice. Results showed that methamphetamine accelerate sexual behavior of female mice with the accelerate nervous activity in medial amygdala and ventromedial nucleus of the hypothalamus. But the role of chronic methamphetamine abuse effects on risky sexual behavior is not clear yet, and this probability that disorder in cognitive abilities stem from chronic methamphetamine abuse can affect decision making or risky sexual behavior have been ignored in these studies.

However due to different studies (13,16, 17) that explained structural and functional changes in brain because of repeated and chronic methamphetamine abuse, we can argue that cognitive functions in chronic meth abusers is completely disordered. Indeed the results of using tools in recent study for measurement of cognitive functions showed that in compare with standard average (100), the averages of cognitive functions for three abilities of attention control, cognitive flexibility and executive control are 73.59, 58.37, and 53.81 that demonstrate extreme damage in these abilities, especially cognitive flexibility, in chronic methamphetamine abusers. So with due to prevalence sexual behavior between sample of the recent study and intensity of cognitive damages it appears that part of risky sexual behavior between this individuals is related to disorder in their cognitive functions.

The results of the correlation tests also in this situation argue about the relation between cognitive functions and total score and score of risky sexual behavior subscales. For example, in addition to continuous attention and attention control had significant correlation with total score of

risky sexual behavior, continuous attention had significant correlation with unsafe sex with fixed sexual partner and unsafe sex with casual sexual partner, attention control had significant correlation with unsafe sex with casual sexual partner and anal sex. Also, cognitive flexibility had significant correlation with unsafe sex with monetary sexual partner, and executive control had significant correlation with unsafe sex with fixed sexual partner. As we anticipated, function in continuous attention had negative relation with risky sexual behavior, but attention control had positive relation with risky sexual behavior. About positive relation between disorder in continuous attention due to risky sexual behavior we can say that although there is no study that divests continuous attention role in risky sexual behavior but studies that consider risky sexual behavior in samples with attention deficit disorder who suffer main deficiency of attention specially in continuously attentions, have reported the prevalence of risky sexual behaviors between these participants. For example, in the newest studies in this field, Van, Flory and Willis (35) in study on scholars, Sarver, McCart, Sheidow and Letourneau (36) in study on teenagers and Hosain, Berenson, Tennen, Bauer and Wu (37) in study on young samples argued that there is relation between this disorder and different kinds of risky sexual behaviors.

Although there is little information about the effect mechanism of continuous attention disorder on risky sexual behavior, but this relation can be due to relation of continuous attention and decision making. Indeed, attention is operational step in information

processing and makes a base of all cognitive functions. So, decision making also like all the cognitive function require attentional resources and disorder in continuous attention with limitation of attentional resources may result in disorder of decision making and in this way risky sexual behavior. The positive relation between attentional control and risky behavior was far to expectation but it demonstrates that for hunching sexual partner and making sexual relation we need minimum of abilities in some of cognitive domains.

Thus this study has limitations that may limited its generalization, also gathering data from 6-month period before entry to camp, and related information about cognitive functions were gathered in time of attendance in treatment camps, may be the attendance in camps causes week relation between cognitive functions and risky sexual behavior. Also with due to this point that recent study conducted on men, generalization of results to the other groups like healthy people, abuser of other substances or females abuser may be have some problem and doing the other studies on the groups became necessary.

Conclusion

Findings demonstrated that risky sexual behaviors are prevalent in methamphetamine abusers and cognitive deficits are related to risky sexual behaviors among methamphetamine abusers.

Acknowledgement

The authors appreciate all people who cooperate with us kindly in this study. There is no conflict of interest.

References

1. Hittner JB, Schachne ER. Meta-analysis of the association between ecstasy use and risky sexual behavior. *Addict Behav* 2012; 37(7): 790-6.
2. World Health Organization. Sexually transmitted infections (STIs). Available from: <http://www.who.int/mediacentre/factsheets/fs110/en>. 2013.
3. Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2011. Atlanta: Department of Health and Human Services; 2012.
4. Paquette R, Tanton C, Burns F, Prah P, Shahmanesh M, Field N, et al. Illicit drug use and its association with key sexual risk behaviours and outcomes: Findings from Britain's third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). *PLoS One* 2017; 12(5): e0177922.
5. McKenna SA. Navigating the risk environment: Structural vulnerability, sex, and reciprocity among women who use methamphetamine. *Internat J Drug Policy* 2014; 25(1): 112-5.
6. United Nations Office on Drugs and Crime. World Drug Report 2015. United Nations publication; 2015.
7. Anglin MD, Burke C, Perrochet B, Stamper E, Dawud-Noursi S. History of the methamphetamine problem. *J Psychoactive Drugs* 2000; 32(2): 137-41.
8. Logan BK. Methamphetamine- effects on human performance and behavior. *Forens Sci Rev* 2002; 14(1-2): 133-51.
9. Semple SJ, Patterson TL, Grant I. Motivations associated with methamphetamine use among HIV+ men who have sex with men. *J Subst Abuse Treat* 2002; 22(3): 149-56.
10. Diaz RM, Heckert AL, Sanchez J. Reasons for stimulant use among Latino gay men in San Francisco: a comparison between methamphetamine and cocaine users. *J Urban Health* 2005; 82(1 Suppl 1): i71-8.
11. Ersche KD, Fletcher PC, Lewis SJ, Clark L, Stocks-Gee G, London M, et al. Abnormal frontal activations related to decision-making in current and former amphetamine and opiate dependent individuals. *Psychopharmacol* 2005; 180(4): 612-23.
12. Cho AK, Melega WP. Patterns of methamphetamine abuse and their consequences. *J Addict Dis* 2002; 21(1): 21-34.
13. Chang L, Cloak C, Patterson K, Grob C, Miller EN. Possib Compens Response 2016; 57(9): 967-74.
14. Tobias MC, O'Neill J, Hudkins M, Bartzokis G, Dean AC, London ED. White-matter abnormalities in brain during early abstinence from methamphetamine abuse. *Psychopharmacol* 2010; 209(1): 13-24.
15. Thompson PM, Hayashi KM, Simon SL, Geaga JA, Hong MS, Sui Y, et al. Structural abnormalities in the brains of human subjects who use methamphetamine. *J Neuroscience* 2004; 24(26): 6028-36.
16. Berman SM, Voytek B, Mandelkern MA, Hassid BD, Isaacson A, Monterosso J, et al. Changes in cerebral glucose metabolism during early abstinence from chronic methamphetamine abuse. *Molecul Psychiatry* 2008; 13(9): 897-908.
17. Courtney KE, Ray LA. Methamphetamine: An update on epidemiology, pharmacology, clinical phenomenology, and treatment literature. *Drug and alcohol dependence*. 2014;143(1):11-21.

18. Goldstein RZ, Volkow ND. Dysfunction of the prefrontal cortex in addiction: neuroimaging findings and clinical implications. *Nat Rev Neurosci*. 2011;12(11):652-69.
19. Friedman NP, Miyake A, Young SE, Defries JC, Corley RP, Hewitt JK. Individual differences in executive functions are almost entirely genetic in origin. *J Experim Psychol Gen* 2008; 137(2): 201-25.
20. Sofuoglu M, Devito EE, Waters AJ, Carroll KM. Cognitive enhancement as a treatment for drug addictions. *Neuropharmacology* 2013; 64: 453-63.
21. Grégoire S, Rivalan M, Le Moine C, Dellu-Hagedorn F. The synergy of working memory and inhibitory control: Behavioral, pharmacological and neural functional evidences. *Neurobiol Learn Memory* 2012; 97(2): 202-12.
22. Fernández-Serrano MJ, Pérez-García M, Verdejo-García A. What are the specific vs. generalized effects of drugs of abuse on neuropsychological performance? *Neurosci Biobehav Rev* 2011; 35(3): 377-406.
23. Monterosso JR, Aron AR, Cordova X, Xu J, London ED. Deficits in response inhibition associated with chronic methamphetamine abuse. *Drug Alcohol Depend* 2005; 79(2): 273-7.
24. Scott JC, Woods SP, Matt GE, Meyer RA, Heaton RK, Atkinson JH, et al. Neurocognitive effects of methamphetamine: A critical review and meta-analysis. *Neuropsychol Rev* 2007; 17(3): 275-97.
25. Parsegian ABGW, Lavin A, See RE. Methamphetamine self-administration produces attentional set-shifting deficits and alters prefrontal cortical neurophysiology in rats. *Biol Psychiatry* 2011; 69(3): 253-9.
26. Hansen NS, Thayer RE, Feldstein Ewing SW, Sabbineni A, Bryan AD. Neural correlates of risky sex and response inhibition in high-risk adolescents. New York: John Wiley and Sons, Inc; 1977.
28. Robbins TW, Sahakian BJ. Computer methods of assessment of cognitive function. In: Copeland JRM, Abou-Saleh MT, Blaziers DG. (editors). *Principles and practice of geriatric psychiatry*. Chichester: John Wiley and Sons; 1994.
29. Strauss E, Sherman EMS, Spreen O. *A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary*. 3rd ed. New York: Oxford University; 2006.
30. Darke S, Hall W, Heather N, Ward J, Wodak A. The reliability and validity of a scale to measure HIV risk-taking behavior among intravenous drug users. *AIDS (London, England)* 1991; 5(2): 181-5.
31. Petry NM. Reliability of drug users' self-reported HIV risk behaviors using a brief, 11-item scale. *Subst Use Misuse* 2001; 36(12): 1731-47.
32. Meade CS, Watt MH, Sikkema KJ, Deng LX, Ranby KW, Skinner D, et al. Methamphetamine use is associated with childhood sexual abuse and HIV sexual risk behaviors among patrons of alcohol-serving venues in Cape Town, South Africa. *Drug Alcohol Depend* 2012; 126(1-2): 232-9.
33. Holder MK, Hadjimarkou MM, Zup SL, Blutstein T, Benham RS, McCarthy MM, et al. Methamphetamine facilitates female sexual behavior and enhances neuronal activation in the medial amygdala and ventromedial nucleus of the hypothalamus. *Psychoneuroendocrinology* 2010; 35(2): 197-208.
34. Fernández MI, Bowen GS, Warren JC, Ibañez GE, Hernandez N, Harper GW, et al. Crystal methamphetamine: A source of added sexual risk for Hispanic men who have sex with men? *Drug Alcohol Depend* 2007; 86(2-3): 245-52.
35. Van Eck K, Flory K, Willis D. Does distress intolerance moderate the link between ADHD symptoms and number of sexual partners? *Attention Deficit Hyperactivity Disord* 2015; 7(1): 39-47.

36. Sarver DE, McCart MR, Sheidow AJ, Letourneau EJ. ADHD and risky sexual behavior in adolescents: conduct problems and substance use as mediators of risk. *J Child Psychol Psychiatr Allied Discipl* 2014; 55(12): 1345-53.
37. Hosain GM, Berenson AB, Tennen H, Bauer LO, Wu ZH. Attention deficit hyperactivity symptoms and risky sexual behavior in young adult women. *J Women Health* 2012; 21(4): 463-8.

