Measurement of Drug Craving in Persian Speaking Subjects; a Review on Current Experiences and Future Perspectives

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Article information	Abstract
	Background: Drug craving is considered as one of the main cores of drug dependency and addiction. Multidimensionality of drug craving, its cultural-bounded features and its intra individual rapidly changing nature makes it difficult to be measured. Nowadays, regarding different psychometric approaches, there are various instruments available for measurement of different aspects of drug craving but mainly for Latin-based languages in North America and European countries. High prevalence and special conditions, and unique subcultures in substance abuse and addiction in many countries, like Iran, make the design of culturally validated instruments for drug craving assessment priority. ***Materials and Methods***: Comprehensive review on drug craving measurement instruments for Persian speaking subjects have been performed by searching in databases (ELSEVIER, Science Direct and Scientific Information Database (SID)) and investigating of related documents on regional experiences. ***Results***: In this article seven main categories of drug craving instruments have been reviewed focusing on validated versions in Persian language including: self-reports, reinforcement "proxies", drug self administration, psycho physiological responding, neurobiological responding, cognitive processing and expressive methods. ***Conclusion***: Reviewing on weak and strength points of each instrument group and national and regional experiences shows that designing and validating a new series of ecologically-validated instruments for multidimensional measurement of drug craving in different addiction subcultures should be prioritized to cover current methodological gaps in substance abuse studies in Iran.

Introduction

Various definitions have been posed for drug craving. This cognitive phenomenon has been analyzed according to different approaches. Clinical researchers and addiction specialists use "*craving*" term to describe various situations such as desire, wanting and liking, urgency, affection, need, intention, or compulsivity for drug abuse [1, 2]. In many references, craving is defined as "tendency to abuse drugs". Thus, the subjective experience or conscious personal experiences constitute the main core of this phenomenon [3, 4]. Drummond believes craving is *the conscious experience to abuse drugs*; while other authorities oppose to this theory and pose the unconscious implicit aspects of behaviors underwent to drug abuse as one of the dimensions of drug craving [5, 6]. However, craving can be considered to be a personal implicit and explicit experience of a multi-dimensional phenomenon blend with desire to achieve a good feeling and/or overcoming a bad feeling [7]. Most important difficulties to define craving are: its multi-dimensional nature, its variations over the time and different interpretations of craving in various people and cultures [2, 7-9]. Different models have been suggested to describe craving, out of which phenomenological [2], psycho-biologic [2, 5, 6, 10-

11], conditioning and emotional models [2, 6, 12, 13, 14-15] can be enumerated as the most important models. It seems that the designers of craving measurement instrument have been influenced by different approaches to craving concept and its emergence process.

Materials and Methods

In this article, regarding the validated instruments in Iran, drug craving measurement instruments have been classified and introduced through seven main groups:

1.Self-report instruments

Almost all of the theorists in the field of drug craving believe that at least a part of craving assessments must be undergone through measuring the self-reports expressed by the subject. Such instruments are used increasingly, because they not only have a high rate of face validity, but also have a simple structure and could be used easily [5]. Self reported questionnaires must be provided with the following conditions [16]: First of all the questioned items and terms used in the form should have a same meaning for subjects and researchers. The second issue is that the subjects must be at least to some extent psychologically minded and have a declarative insight

toward their feelings and cognitive processing. The distorted reports are common because of the defensive mental state of the subject and/or their ignorance to the craving phenomenon. Third, the subject must issue honest responses, so inserting several questions in drug craving questionnaires to examine the subject's trustworthiness is suggested and finally, the theoretical framework of the designed research project and also the terms and concepts used in designing the questionnaire must follow similar principles. It is crystal clear that regarding the linguistic difficulties, cultural differences, difficulty to make relation and dishonesty of the addicted patients, achieving an ideal result in such self reports is difficult. The researchers of this field must be sensitive on memory biases and the addicted patients' special behavioral and cognitive indicators, which may be basically unrelated to the concept of craving, but influence the assessment outcomes [1, 17]. Therefore, the data collected from the questionnaires, which need a retrospective recall or proposing a general conclusion of the previous experiences of an individual (for instance, generally how much did you feel craving before treatment?) should be interpretated cautiously [18].

There are numerous methods to improve self-reports designed for assessments of different dimension in drug craving. For instance, questionnaires can be designed so that the subject does not consider their craving is being under assessment, or we can prepare a condition in which answers are not judged morally as good or bad by the subject. Accordingly, several questionnaires have been designed, trialed and introduced to appraise craving in various cases. There are limited experiences on such questionnaires in Iran, which are pointed out later. In this paper, the self-report instruments are divided into two main classes:

A) Self-report instruments for basic levels of craving

Desire for Drug Questionnaire (DDQ) and Obsessive Compulsive Drug Use Scale (OCDUS) examine drug craving in opiate addicted patients either in the present time (DDQ) or during the last week (OCDUS). Franken had adapted the questionnaires from two questionnaires designed to evaluate alcohol abuse craving, namely Desire for alcohol questionnaire and OCDUS [19-20]. In fact DAQ form has originated in Yale-Brown Obsessive Compulsive Scale (Y-BOCS) questionnaire [21]. DAQ is a summarized and changed form of Alcohol Craving Questionnaire [22].

OCDUS is made of three factors; the first factor addresses thoughts related to heroin abuse and their effect in the addicts' life; the second factor which examines craving and ways to control it, evaluates resistance against tempting thoughts and decision to abuse. DDQ has also consisted of three main elements including desire and intention to abuse, negative reinforcement and control. In Iran, have been validate for OCDUS and DDQ for Crack, Heroin, and Methamphetamine abusers [23, 24]. Authors have shown that "control" concept could not be well understood by drug addicts in Persian language in the DDQ questionnaire. But, "desire and tendency" toward drug abuse is the main factor that receive the same score in the same questions as the original version of DDQ.

B) Self-report instruments for induced levels of craving

Various methods have been used to induce craving; recalling autobiographic memories, inducing negative mood, using drug's taste or scent, displaying audio or video signs and proposing words and terms which are related with the drug abuse are of the most important methods of inducing craving. The fundamental hypotheses of the drug craving induction using cue reactivity or emotional states is that for the different people and condition there are different response levels for the craving induction, as a function of craving reactivity phenotype [25]. In Iran, there are various instruments to estimate craving which have been designed and validated using induction methods. Preparing and analyzing five visual tasks for analyzing craving in various opioid addicted people and visual tasks for methamphetamine users are some of such methods [26, 27]. Terms which induce methamphetamine craving and terms which are common among Iranian drug abusers were also studied [27, 28].

2. Measurements for drug reinforcement

If craving is considered as a reflection of temptation to abuse drugs, the craving level can be evaluated based on the addict's prediction of the reward caused by abusing drugs (positive reinforcement effect). Such kind of prediction can be evaluated using different methods [29, 30]. In Iran few studies have been conducted using this paradigm so far [31].

One way to evaluate this indicator is analyzing the whole amount or effort a man or animal is ready to perform in order to achieve and use substances [32]. It is crystal clear that applying this paradigm is difficult for the human models. According to the behavioral economics models, this indicator can be quantified through analyzing the subjective choice between taking some money and/or gaining substances. If our subject passes more money up with the hope achieving substance, then the substance reinforcement value will be more in that individual. However, the application of this method has several limitations; for instance, 1 USD has different values for a needy and a rich man. Likewise, in this condition, other incentives such as "trying to remain sober" disturb the 1:1 equation of the incentive to take money and the incentive to gain drugs. In a study on methamphetamine dependents using this paradigm, authors showed that the amount of requested drug is not reduced with escalating price. It could show that the tradeoff between drug and money cannot be easily modeled linearly. Indeed, further studies are needed to demonstrate the applicability of this method.

3. Self administration

For researchers who consider craving ultimately as a behavioral reflex of an intention to drug consumption, in contrast to the self-reports of a personal experience, measuring the drug abuse behavior could be a better indicator for assessing the craving [33]. For researchers who do not believe in the concept of the *subjective craving* [34], investigators who rely more on animal

models to assess drug craving and also for researchers who believe in the unconscious dimensions of craving, self-administration would be a selected option. Of course, the point must be considered that many researchers believe that necessarily craving does not stimulate individual to abuse drugs, likewise, craving is not a necessary condition for abusing drugs. Therefore, the relationship between behaviors of abusing drugs and craving are not based on a strong cause and effect framework. Different researches have used various indicators to evaluate the drug abuse behavior as an indicator of craving. For example, the interval between leaving a treatment course and the first drug relapse is one of the most common indicators in this issue. Similarly in different studies, various variables including dose of drugs, frequency, intensity to puff a cigarette and the interval between puffs (through studies on desire to smoke cigarette) have been used in this regard [35, 36].

4. Psycho-physiologic response

According to a number of the proposed models, the psycho-physiologic changes such as heartbeat, body temperature, blood pressure, skin conductance and salivation can be used as an indicator for showing craving. The dominant hypothesis of such indicators is that the mentioned factors are rarely controlled consciously by subjects; hence they enjoy higher validity than the self-reports [3, 37].

However, using these methods are hesitated, because any change in these factors necessarily does not directly relate to the craving. For instance, the increased heartbeat during tests designed to stimulate craving would be due to man's physical endeavor tackle stimulation signs of craving. Also, it seems that the physiologic changes reported by studies on various drugs show different states. Likewise, there are inconsistent results for a certain drug (e.g. either the increased or decreased heartbeat) [4, 38]. However, please keep in mind that using such instruments is often for developing certainty of evaluation rather than demonstrating the approved related theories [22]. There were no published experience in this regard in Iran while we setting down the article, although Ekhtiari et al. had been pointed to the changes of the patients' physiologic changes after facing the craving inducing cues among heroin injectors. Ekhtiari, et al. reported that although the personal report showed high or medium levels of excitement (subjective craving self-report) due to displaying craving inducing images, the images' capacity to develop physical signs of craving such as cramps, sweating, or heart palpitations were low.

5. Neurobiological response

Analyzing neurobiological changes influenced by the craving stimulations is an objective and proper instrument to examine effects of craving. Using Position Emission Tomography (PET) or Functional Magnetic Resonance Imaging (fMRI) and also trying Quantitative Electro Encephalo Graphy (QEEG) have brought about a revolution in identification the neurologic infrastructure of craving processing. Researches based on fMRI show effect of brain's various parts including the middle part of prefrontal as well as basal ganglia and pre-motor lobes on

processing the inducing visual signs of craving [39, 40]. Authors have experienced using culturally validated fMRI tasks for craving induction among Persian speaking Heroin and Methamphetamine users [36].

6. Cognitive processing

The viewpoint according which the drug craving is caused and assessed by a series of cognitive processing is a well developed [15, 41]. Accordingly, it is believed that regarding the limited cognitive capacity of individuals, if the craving stimulation test is conducted in association with another test, which needs quick response, the increased response time of individuals in the second test because of its association with the craving process would somehow indicate the intensity of craving [42].

Another cognitive method of craving assessment is using verbal memory recall methods. Different studies have shown addicts recall more words related to addiction during their abstinence period. In fact, the subjects memorize the salient words with higher quality. The amount of this positive influence on the memory can be an indicator of drug craving [43]. Using implicit evaluation of the hidden memories, which are related to drug abuse, we can assess craving intensity. Using different paradigms such as color Stroop with neutral words and words related to drug abuse (craving inducing words) and also analyzing the different time lags in responding to color of the two word groups are examples of using such methods; however, here the unconscious processing of craving are emphasized and attention bias toward salient cues are considered mainly. In order to appraise drug craving using cognitive processing evaluation, levels of attention bias toward drug related cues is posed as a cognitive marker for drug craving and the related behaviors. The attention deviation means that a secondary (or destructive) factor does not let us to focus our attention on other information; in this special case, the secondary factor is nothing but cognitive processes related to drugs. There are two major practical instruments to evaluate and analyze attention deviation: the Addiction Modified Stroop Task (AMST) and Dot Probe Task (DPT) (with pictures and words).

In Iran both instruments have been designed and trailed for Persian-spoken people in the Neurocognitive Laboratory of Iranian National Center for Addiction Studies in order to evaluate attention deviation in various cases of drug abuse [28, 44-45].

A. Addiction Modified Stroop Task (AMST): Stroop Task tests have widely been used as a instrument to appraise the selective attention mechanisms [45]. The Stroop paradigm is posed as a standard reference in the attention related evaluations [44]. Recently, numerous studies have used the corrected (or emotional) version of the Stroop task to analyze whether people in confrontation with stimuli related to an important subject and/or to their pathology show attention deviation [45].

B. Dot Probe Task (DPT): In the classic DPT the monitor screen is divided in two equal parts which are separated with a fixation point at the middle which is shown usually with a plus sign (+). There is a symmetrical square or rectangular box on both parts of

the screen. When the fixed central dot is removed, the screen shows simultaneously two words or pictures, one is drug related and another is neutral. These two stimuli will be disappeared after a predefined time and a target sign such as an star will be appeared in one side instead of one of the words or pictures; now, the subject must specify the side on which the target sign or "*" has been appeared. In this test, either stimulus or neutral elements are shown randomly, but the frequency of stimulus and neutral factors, which are shown in both sides, are counterbalanced. . In Iran, few studies have been conducted using these tasks [25, 42, 46].

7. Facial emotion expression

Studying face various muscles tonus changes and/or in other words facial emotion expression is a way to study emotional-cognitive processing condition[15]. Given the emotional bases of the craving related processing, systems, which are able to process, people's portraits upon facing craving induction condition are used as an indicator to analyze craving. Using face pictures computerized processing techniques using facial action coding system (FACS), infra red cameras are employed to analyze skin thermal changes and electromyography applications. There is no published experience in this regard in Iran or around the world.

Challenges and concerns in craving measurement in Persian-speaking subjects

The major problems of using the available instruments for evaluating the drug craving can be categorized as follows:

1. Designing Validated and Reliable instruments

The reliability of the craving measurement instruments seriously faces several challenges. The reason for low reliability can be interpreted in the fact that craving is not a constant and fixed parameter, but it varies over time. Meanwhile, most of the instruments used in various studies have not been validated properly so far. Validation of craving measurement instrument enjoys a special importance. Face, contextual and structural validation of such instruments has been posed and it has been emphasized that analysis of the convergent validity and discriminate validity are the best options for craving evaluation[16]. There is a number of simple and easy-to-use instruments usually used to evaluate craving, particularly self-report questionnaires, but most of them need serious revisions in terms of reliability and validity. There is a wide range of terms used in specific culture of Iranian drug abusers. Applying Persian terms in questionnaires can be considerably effective in developing ecologically validated instruments.

2. Developing instrument for specific groups of drug abusers

Each drug of abuse has its own psychological and somatic signs and symptoms during intoxication and withdrawal. There is a serious debate on the applicability of a single craving assessment instrument for different types of drugs of abuse. Designing and validating instrument for evaluating craving level of methamphetamine abusers is an important issue, which must be stressed regarding the increasing number of methamphetamine abusers in Iran. Due to the phasic patterns of methamphetamine abuse, it is possible that the craving severity changes moment to moment. This should be considered during instrument design for these groups of subjects.

3. Proper instrument selection for drug craving measurement

All the introduced instruments in this paper can achieve the best performance in a certain condition. Choosing a proper instrument for evaluating drug craving can play a significant role in increasing precision of the results. Therefore, Iranian addiction scientists cannot satisfy with one or two validated instruments. A menu of validated instruments is needed to cover basic needs to conduct a clinical research targeting drug craving in a group of Persian speaking subjects.

4. Choosing a specific approach to craving concept

Selecting an instrument for evaluating the drug craving depends on an approach, which is selected for define and assess drug craving. Table 1 provides you with a brief description on five main approaches to drug craving and also introduces related instruments. It is usually impossible to use an instrument for measurement of drug craving through a certain approach, and defining craving in the study with another approach

5. Sensitivity of the measuring instruments

The sensitivity and precision of all instruments designed to measure craving are not equal. Collecting very precise information about the craving is not always necessary and is subject to unwanted noise. For example, choosing a non-sensitive instrument with high levels of intra individual variability in pre-post assessment during a psychological intervention usually face with unsatisfying results.

6. Patient's cooperation to craving measurement

Patient's cooperation level to express craving should be considered in choosing the type of the instrument. Instruments designed to measure craving depend differently on the patient's cooperation. This parameter in some of the studies such as functional brain mapping with EEG or fMRI is at the least required level, while patient's cooperation play a vital role in implementing self-reported craving inventories. Interviewing subjects about their attitudes toward "craving self report" and negative feeling such as shame or guilt accompanied with the craving expression during assessments is vital to receive reliable responses. It is necessary to pay attention to the fact that when there is no enough time to attract patient's trust, using instruments, which highly are dependent on patient's cooperation or honesty and trustworthiness, is not justified for craving measurement.

7. Clinical applicability of the instrument

Clinical applicability is very important, particularly during employing instruments that have been designed to measure craving under the framework of the treatment and drug relapse prevention programs. It seems that using a long list of time-demanding instruments increases study costs considerably and decreases patients' cooperation significantly.

Table 1. The suggested tools to analyze desire to abuse drug regarding its expressing approaches

Approach	Brief description	The suggested instruments for craving measurement
Phenomenology	This qualitative model focuses on description of craving, and its main emphasis circles around the personal experiences. The similarities between addiction and Obsessive-Compulsive Disorder symptoms are considered in this model. Usually information about craving are collected through interview and observation the addicts. The interviewee's remarks and observing their feedbacks are the basis of measuring drug abuse craving.	The quantitative measuring instruments such as questionnaires with closed questions cannot be used here. Probably facial expression is able to transfer a part of information about craving in this model.
Psycho-biologic	The long-term impacts of drug abuse on neurologic system and carriers are considered as the predisposing factor of drug craving. Hence, analysis of the neurologic responses and their intensity upon emergence of the craving can be a basis for the drug craving measurement.	Analysis of psycho-physiologic and neurobiological responses; analysis of brain function changes through MRI or ERP
Conditioning	The environmental neutral stimulus will cause conditional responses during the period of drug abuse through conditional learning process. The conditional responses which cause via signs (e.g. watching needle and syringe, or the place were formerly used for drug injection) are similar to withdrawal condition. The conditional leads the subject to relapse because of their inclination to get rid of the undesirable experience of withdrawal symptoms. Analysis of type and intensity of the patient's conditional responses in confronting with the signs will be bases of craving measurement.	Inducing drug craving using signs and measuring self-reporter's craving or physiologic indicators
Motivational	Craving is a part of the two-level motivational structure: momentums/ inhibitors and incentives. The strong attractions are generated from a disorder which is developed due to changes imposed by drugs in the motivational structure. Environmental signs, expectations, conditioning, emotional disorder, brain sensitization and moment events and accidents can facilitate craving.	Equalizing the drug enforcement value (risky decision making tasks)
Cognitive	Craving is rooted in the false beliefs in patient's need to drug. For instance the positive expectations from drug abuse could be a trigger for craving. It seems that drug craving is controlled by both automatic and non-automatic cognitive processes.	Cognitive process tests including stroop tests such as simple stroop, emotional stroop and addiction special stroop and picture/word computer dot probe test

8. Study Type

Monitoring of the effects caused by a specific therapeutic intervention for drug addiction is one of the most important applications of the instruments designed to measure craving. The study design, predicted effect size, variability of collected information and sensitivity required to detect the effect can be deterministic in choosing a proper measuring instrument.

Conclusion

Relapse to drug abuse is not surprising during addiction treatment but we can achieve the evidence showing the increased risk before any relapse. Many researchers introduce craving as the most important cause of the relapse. Hence, measuring the craving level can play a significant role in selecting the best relapse prevention strategies. As mentioned in this paper, defining and measuring the craving face with several difficulties because of its nature. Many instruments have been designed and validated for measuring the craving, out of which seven main types were reviewed in this paper. For selecting any instrument introduced in this paper, following factors must be considered; the selected approach to express drug abuse craving, sensitivity and precision range of the measuring instrument, patients' cooperation during the craving measurement , clinical applicability and type of study in which the instrument is to be used.

Craving considerably varies from time to time, thus the available instruments are not able to record the craving, which is associated with the relapse. For instance, the instruments which connect the long periods, e.g. measuring the average value of craving within the past

week, or methods which measure the craving in a distant time point, e.g. at the beginning of the treatment program, suffer from a weak predicting capacity.

Various studies have examined separately the effect of the biological, psychological, socio-cultural and chronological elements in the drug craving. In order to achieve a comprehensive understanding of the drug craving, designing a model to express the phenomenon through various aspects and in a unified form is necessary [9]. On the other hand, regarding the poor validity and reliability of the instruments, which examine only one aspect of the drug abuse craving, designing and validating multi-dimensional instruments have been considered drastically [47]. With regard to the current shortages of the introduced instruments, it seems that using exclusively an instrument for measuring the craving will not be reliable. Probably mixed measurements can be more reliable methods for measuring the drug craving.

Regarding the high usage of the self-report methods, because of their simple and inexpensive nature, localization and validation of the sort of measuring instruments, particularly for the new drugs, must be put atop agenda in future. Meanwhile, designing culture independent instruments, using drug craving measurement instrument in treatment and relapse prevention program and necessity of designing and validating instruments to measure craving of main abused drugs in Iran must be emphasized.

Having reliable and valid instruments to measure carving is an essential element in studies focused on drug addiction treatment. Addiction researchers in developing countries like Iran with significant transcultural differences with the dominant western societies should define a roadmap for designing and validating reliable

instruments to measure drug craving in their subjects. Considering pros and cons in each paradigm and referring to drug abusers subcultures to access to their lexicon and terminology is an essential need that should be done carefully. Putting a national priority by Iranian granting agencies on instrument development for drug craving could facilitate and foster this way.

Authors' Contributions
All authors had equal role in design, work, statistical analysis and manuscript writing.

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