Evidence of validity of an inhalant-craving questionnaire

Evidencias de validez de un cuestionario de craving a inhalables

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Abstract

Inhalants are substances widely used as recreational drugs: their addictive potential has been demonstrated by many studies. There is no reported measurable evidence of craving in inhalant users. The main goal of this study was to design and obtain evidence of validity of the score of a questionnaire for the evaluation of inhalant craving (ICQ) in a Mexican population sample. The ICQ is a type of visual analog scale with ten items. Face validity was evaluated by a group of experts in the addiction field. Reviewers considered the completeness, semantics, and sentence structure to guarantee a conceptual representation of the items. The final ICQ was applied to a sample of 520 Mexican high school students, 46% women and 54% men, between 12-19 years of age (*M*=15.18; *SD*=1.48), from 7th to 12th grades. The internal consistency of the ICQ showed a Cronbach's Alpha of 0.947. The 10 items were grouped into one single factor, with a factor loading above 0.74 for each of them. ROC analysis breakpoint was located at 18.5 mm with a sensitivity of 0.855 and specificity of 0.753. Thirty-three per cent (n= 172) of the student population evaluated reported the use of inhalants at some point in their lifetimes, with an average of misuse beginning at 13.6 years of age. The ICQ showed adequate psychometric properties, suggesting that the instrument may be considered a useful tool for screening for craving in young inhalant users.

Keywords: Inhalants, craving, addiction, adolescent, clinical assessment.

Resumen

Los inhalables son sustancias ampliamente utilizadas como drogas recreativas: su potencial adictivo ha sido demostrado por numerosos estudios. No hay reportada evidencia medible del *craving* en usuarios de inhalables. El objetivo principal de este trabajo fue diseñar y obtener las evidencias de validez de las puntuaciones en un cuestionario para la evaluación del *craving* a sustancias inhalables (ICQ) en una muestra de población mexicana. El ICQ es un tipo de escala análoga visual de diez ítems. La validación de apariencia fue evaluada por un grupo de expertos en el campo de las adicciones. Los revisores consideraron la integridad, la semántica y la estructura de los enunciados, para garantizar una representación conceptual de los ítems. La versión final del ICQ fue aplicada a una muestra de 520 estudiantes mexicanos, 46% mujeres y 54% hombres, con edad comprendidas entre 12-19 años (*M*=15.18; *SD*=1.48), con años de escolaridad entre 7-12 años. La consistencia interna del ICQ mostró un Alfa de Cronbach de 0.947. Los 10 ítems se agruparon en un solo factor, con una carga factorial por encima de 0.74 para cada uno de ellos. El análisis ROC mostró que el punto de corte se localizó a 18.5 mm con una sensibilidad de 0.855 y especificidad de 0.753. El 33% (n=172) de la población de estudiantes evaluados reportó el uso de inhalables en algún momento de su vida, con un promedio de edad de inicio de 13.6 años. El ICQ mostró propiedades psicométricas adecuadas, lo que sugiere que el instrumento puede ser una herramienta útil para el tamizaje de *craving* en jóvenes usuarios de inhalables.

Palabras clave: Inhalables, *craving*, adicción, adolescentes, evaluación clínica.

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Abused inhalants contain volatile substances that are self-administered as gases or vapors to induce a psychoactive or mind-altering effect (Balster, Cruz, Dell & Cottler, 2009). These substances are available in legal, relatively inexpensive and common household products (National Institute on Drug Abuse [NIDA], 2012). Among the products most commonly abused by young people are: paint thinner, school supplies (markers, felt pens, correction fluid), spray paints and glues (Lubman, Yücel & Lawrence, 2008; Substance Abuse and Mental Health Services Administration [SAMHSA], 2008). Solvents constitute the most abundant class of volatile substances; they evaporate rapidly at room temperature and are usually inhaled through the nose and mouth. They have different chemical structures, and different names are used for a single compound. However, among them, toluene has been the most studied, and is likely the most commonly abused volatile solvent globally (Cruz, 2011).

In inhalation of volatile substances, a marked variability is seen in the type of substances abused and the pattern of consumption in each country (Elkoussi & Bakheet, 2011; Hynes-Dowell, Mateu-Gelabert, Taunhauser & Delva, 2011; Vazan, Khan, Poduska, Stastná and Miovský, 2011). For example, the National Addiction Surveys conducted studies in schools in Australia and North America that indicated high rates of experimental inhalant use during early adolescence, as high as 26% of 12 year old students (Johnston, O'Malley & Bachman, 2003; White & Hayman, 2004). It is estimated that in the United States, up to two million teenagers, between 12 and 17 years of age, have at some time used an inhalant (Howard, Bowen, Garland, Perron & Vaughn, 2011; Wu, Pilowsky & Schlenger, 2004). In Mexico, it has been estimated that 77% of inhalant users are younger than 18 years of age (Encuesta Nacional de Adicciones [ENA], 2011); they usually start between the ages of 12 and 14 years. Global prevalence of inhalant misuse used to be higher among marginal groups, the mentally ill or young people in conflict with the law, but nowadays it is a widespread practice in the general population (Gigengack, 2013; Villatoro, Cruz, Ortiz & Medina-Mora, 2011). More recently, a survey conducted in Mexican high school students indicated that volatile substance misuse has increased to become the second drug of choice in this particular population, with a prevalence of 9.7% in males and 10.3% in females (Villatoro, Medina-Mora, Hernandez, Fleiz, Amador, & Bermúdez, 2005; Villatoro, Medina-Mora, Fleiz-Bautista, Téllez-Rojo, Mendoza-Alvarado & Romero-Martínez, 2012; Villatoro et al., 2013). Volatile substances are the third choice of drugs in the general population (ENA, 2011). In addition, in this country there are significant regional variations in the rates of treatment demand. In the central region, inhalants represent 11.6% of cases in treatment. In the south, only 4.8% of inhalant users seek medical help (Medina-Mora & Real, 2013).

The immediate effects of inhaling solvents are similar to the early stages of alcohol intoxication in low concentrations: initial euphoria and excitation are caused by the suppression of inhibitory brain functions. At higher concentrations, inhibition occurs in the nervous system in general. Both solvents and alcohol exert depressive effects (Cruz, 2011).

Chronic inhalant use is associated with numerous medical consequences; however, the most commonly reported are neurotoxicity and psychiatric issues (Bowen, Batis, Paez-Martinez & Cruz, 2006; Kurtzman, Otsuka & Wahlet, 2001; Lubman et al., 2008; Ridenour, Bray & Cottler, 2007). Patients show peripheral neuropathy, cerebellar dysfunction, cranial nerve damage, cortical atrophy and encephalopathy (Anderson & Loomis, 2003; Finch & Lobo, 2005; Gautschi, Cadosch & Zellweger, 2007; Lubman et al., 2008; Morrow, Steinhauer & Condray, 1998;). Furthermore, cognitive dysfunction (e.g. attention problems, learning and memory, psychomotor function, executive abilities, and speed of information processing) and comorbidity with mental health disorders (e.g. antisocial behavior, anxiety, major depression, suicide ideation and suicide attempts, and polydrug use) have been reported with regular, long-term exposure (Howard, Perron, Vaughn, Bender & Garland, 2010; Howard et al., 2011; Yücel, Takagi, Walterfang & Lubman, 2008). This long-term use is linked to social destructive effects, and poor academic performance. Both consequences have an impact on the budgets of health and welfare systems (Dell, Gust & MacLean, 2011).

Like any other addictive substances, prolonged inhalant abuse requires the support of medical professionals (NIDA, 2012). Addiction is a chronically relapsing disease, characterized by drug intoxication, craving, binging, and withdrawal, with loss of control over drug-related behaviors (Parvaz, Alia-Klein, Woicik, Volkow & Goldstein, 2011). Specifically, craving is included as one of the diagnostic criteria for addiction; it is defined as a strong desire or compulsion to take drugs, immediately after withdrawal (Drummond, 2001; O`Brien, Childress, Ehrman & Robbins, 1998). The craving phenomenon has been described as the result of neuroadaptive changes in cortical and subcortical structures such as the dorsolateral prefrontal cortex and amygdala, and has been considered a key element to take into account when developing and testing the efficacy of treatments for substance abuse disorders (Goldstein, Craig, Bechara, Garavan, Childress, Paulus & Volkow, 2009; Koob & Volkow, 2010; Grant et al., 1996).

Several tests for craving assessment have been developed for commonly abused drugs such as cannabis (Heishman, Evans, Singleton, Levin, Copersino, & Gorelick, 2009), cocaine (Tiffanny, Singleton, Heartzen & Henningfield, 1993), alcohol (Guardia-Serecigni, Segura, Gonzalvo, Trujols, Tejero, Suárez, & Martí, 2004), nicotine

(May et al., 2014), and even food, for instance, chocolate (Cartwright & Stritzke, 2007; Pelchat, 1997; Rodgers, Stritzke, Bui, Franko & Chabrol, 2011). The cognitive process model of conceptualization is the one that best fits the craving phenomenon. This model suggests that among the different techniques and instruments one can possibly use, self-report is the one that often provides better information about a patient's craving, and plays a major role in its measurement (Tiffanny & Wray, 2012; Tiffany, Niaura, Martin & Shadel, 2000; Sayette, Shiffman). One such self-report is the Cocaine Craving Questionnaire Now (CCQ). The CCQ is a ten item Likert scale instrument that measures craving at the moment in which the evaluation is taking place and it is one of the most commonly used tests (Tiffanny et al., 1993; Marín-Navarrete et al., 2011). Another commonly used test is the Multidimensional Alcohol Craving Scale (MACS), which uses twelve items to evaluate two factors: craving for a drink and behavioral disinhibition. MACS discriminate among intensity levels of dependence (severe, moderate, and mild). Both CCQ and MACS have been translated and adapted to Spanish-speaking populations and also possess adequate psychometric properties and internal consistency (Guardia-Serecigni et al., 2004; Marín-Navarrete et al., 2011).

Despite the fact that current data demonstrate that dependence on inhalants is a real phenomenon (Perron, Howard, Vaughn & Jarman, 2009; Ögel & Coskun, 2011) and clinical behavioral evidence shows that craving is a key component in this process (Volkow et al., 2006), so far there has been no measurable evidence of craving in inhalant users. This has been because to our knowledge there are no clinical tools to assess this phenomenon. A questionnaire with reliable scores from which to make valid inferences to measure craving in the dependent population would be a useful research and clinical tool to improve medical diagnosis and to make better treatment decisions. Thus, the main goal of this study was to design and obtain evidence of the validity of the score of a questionnaire for evaluation of inhalant craving in a Mexican population sample. We hypothesized that in an asymptomatic young population, non-users would obtain lower scores (and closer to zero) than those obtained by inhalant users.

Methods

Participants

All participants were recruited from schools in the metropolitan area of the city of Puebla, which is located in the central part of Mexico. 555 students participated, but only 520 Mexican high school students with ages between 12-19 years, (M=15.18; SD=1.48), who were studying from 7th to 12th grades, met the inclusion criteria (full questionnaire replies). All participants spoke Spanish as their native language; they were 54% males and 46% females.

Instrument

The Inhalant Craving Questionnaire (ICQ) is a self-administered instrument that has two sections. The first part asks participants for information about drug-use history, such as age of onset, attempts to stop use, frequency of inhalant use, average level of use per occasion and number of years using inhalants. The second section has ten statements indicating different conditions, as shown in the next example: *Señala qué tan fuerte es tu deseo de consumir ___ en este momento que casi puedes sentir su olor.* (Please indicate how strong is your desire to use ___ at this moment, in which you can almost feel its scent). Each one has to be answered in a visual analog scale (VAS). Response options of type VAS consisted of a 100 millimeter line, without divisions. At each end of the printed line there are phrases indicating opposite statements related to each condition, for instance "No deseo" (no desire) at one end and "Más que nunca" (more than ever) at the other. The participant marks the point on the line that best describes the intensity of his desire. The length of the line to the point marked by the students is measured and recorded in millimeters (mm).

Procedure

The study consisted of five stages.

- Stage I. Theoretical and conceptual approach to craving. A review of the literature on this population was made to provide a precise approach, which contributed significantly to development of the instrument.
- Stage II. Instrument design. The literature describes one-dimensional scales for craving assessment. An example of such a scale is the Visual Analog Scale for Heroin. In this kind of evaluation the participant is asked to rank his/her desire to consume on a printed line. The phrase "not at all" is written at one end of the line and "extremely high" at the other end (Eaton, Comer, Revicki, Tredeau, Van Inwege, Stauffer & Katz, 2011).

  The construction of the items was performed based on previously validated scales in Spanish. We first choose two instruments validated in Spanish and commonly used in Mexico to assess craving for other substances: the Cocaine Craving Questionnaire (CCQ) (Marín-Navarrete et al., 2011) and the Multidimensional Alcohol Craving Scale (MACS) (Guardia-Serecigni et al., 2004). Ten items from both scales were selected and adapted for inhalant craving, according to the items in the design guidelines (Moreno, Martínez & Muñiz, 2004).
- Stage III. Judges review. This first version was evaluated by a group of 22 expert researchers and/or clinicians on addictions. In this review the experts evaluated every item, considering comprehensiveness, semantics, phrase structure and face validity. They gave a score to each item in the questionnaire and

commented on it. The score parameters were a maximum of five points and a minimum of one point. The maximum average score of the items was 4.09 and the minimum was 3.41. After this expert review, the questionnaire was modified based on comments from the experts and a second version of the ICQ underwent further evaluation by the authors in order to obtain the final version. Table 1 shows the items in Spanish with the English translation in order to make it easier to read. It should be considered that adaptation in another language must be adjusted to specific populations.

- Stage IV. Application of the questionnaire. It was used as a convenient sampling for this study. Some schools were selected to match the socio-demographic characteristics of inhalant users that commonly go to the Mental Health Center in the city of Puebla. These schools are located in low income, high-risk areas, far away from the city center and supported with public funds. Four schools were contacted and asked for their cooperation in recruiting students. Only three of them agreed to participate in the study. Each of these schools organized a meeting with parents or legal guardians in which the researchers provided information about the study. An informed consent form was given to all those attending the meeting, including students interested in participating in the study. Participation was voluntary; confidentiality and anonymity of responses were guaranteed. The students did not receive any kind of incentive for their participation. To ensure anonymity, the ICQ was applied in groups where participants were seated with enough space between them. Evaluators read the instructions and each of the items to participants. Once they were completed, the questionnaires were placed in a secured box.

  The study was approved by the Research Ethics Committee of the Medical School of the National Polytechnic Institute (ESM-IPN). A written informed consent was obtained from all volunteers and guardians prior to study enrollment, in accordance with the Declaration of Helsinki.
- Stage V. Data analysis was performed to assess the evidence of validity.

Table 1
Items in the ICQ instrument in Spanish with translations into English.

	Items
1	*Señala qué tan fuerte es tu deseo de consumir ___ en este momento (tan fuerte que casi puedes sentir su olor).* Indicate how strong is your desire to consume ___ at this moment (so strong that you can almost feel its scent).
2	*Señala qué tan intenso ha sido tu deseo de inhalar ___ en el último mes.* Indicate how intense your desire to inhale ___ in the last month was.
3	*Señala la frecuencia con la que has deseado inhalar ___ en el último mes.* Indicate how often did you feel the desire to inhale ___ in the last month.
4	*Durante el último mes, señala que tanta urgencia has tenido de inhalar ___ cuando has estado frente a cosas que te lo recordaban (bolsa con pegamento, estopa, lata de PVC, olores, entre otras cosas).* *During the last month, indicate the urgency you felt to inhale ___ when you were exposed to things that reminded you of inhaling (bag of glue, PVC, odors, among other things).*
5	*Imagina que estás en una situación que te recuerda tu consumo de ___. Si estuvieras en esa situación en este momento, ¿Cuál sería la posibilidad de que inhalaras ___?* Imagine that you are in a situation that reminds you of the consumption of ___. If you were in that situation right now, what would be the possibility that you inhaled ___?
6	*¿Inhalarías ___tan pronto como se te presentará la ocasión?.* Would you inhale ___ as soon as you had the opportunity?
7	*Si en el último mes hubiera inhalado ___, no hubiese sido capaz de parar.* If in the last month I had inhaled ___, I would not have been able to stop.
8	*Si en el último mes hubiera tenido delante de mí ___, me hubiera sido muy difícil no inhalarlo.* If in the last month I had had in front of me ___ it would have been very difficult for me not to inhale it.
9	*Inhalar ___ en el último mes me hubiera hecho sentir menos irritable o inquieto.* To inhale ___ in the last month would have made me feel less irritable or restless.
10	*Inhalar ___ en el último mes habría hecho que todo pareciese mejor.* To inhale ___ in the last month would have made everything seemed better.

Data analysis

Descriptive analysis was applied to the demographic data, taking frequencies as categorical variables and central tendency measures as continuous variables.

The internal structure was determined by exploratory factor analysis (EFA). This exploratory analysis was performed on the individual items of the questionnaire, to evaluate which ones were grouped consistently in accordance with the construct theoretical basis. The reliability of the scores of the items was obtained with Cronbach's coefficients.

Student´s T analysis was applied to contrast "users" from "non-users" as sub-populations within the sample and in age groups. These categories were assigned based upon the answers to the items about drug use history.

Receiver Operating Characteristic (ROC) analysis was used to determine ICQ sensitivity and specificity, as well as the ideal cutoff point to differentiate the groups.

Data processing and data analysis were performed using the Statistical Package for the Social Sciences (SPSS), Version 17.0 for Windows.

Results

Each of the item responses was obtained by measuring the distance from the start line to the point marked by the participants. The results are:

Descriptive analysis of ICQ

Average values of the items were ranged in millimeters, where 6.11mm was the minimum (item 7) and 7.39mm the maximum (item 5), with a mean (*M*) summary index of 6.69mm and a standard deviation (*SD*) of 16.14 mm and significance level of p= 0.000, as shown in Table 2. The distribution curve of the ICQ scores gave higher values; the curve showed a symmetry index = 3.48-3.87 and kurtosis = 12.26-16.12.

Internal consistency

The ICQ gave a Cronbach's Alpha = 0.947, which represents a high internal consistency. In addition, all item-total correlations were higher than 0.688, indicating that the scale is composed of homogeneous items, as shown in Table 2.

Table 2
Descriptive data, exploratory factorial analysis and internal consistency of score of the ICQ instrument in Spanish

Descriptive			Reliability		Exploratory factorial analysis	t	gl	Sig.
Item	**Mean**	**SD**	**Correlation Element-Total**	**Alpha if the item is removed**	**Factor loadings**			
1	7.29	15.99	0.770	0.942	0.820	10.39	519	.000
2	6.55	15.35	0.790	0.941	0.837	9.73	519	.000
3	6.38	15.91	0.755	0.943	0.806	9.14	519	.000
4	6.31	15.03	0.827	0.940	0.866	9.57	519	.000
5	7.39	17.30	0.833	0.939	0.869	9.74	519	.000
6	6.92	16.61	0.780	0.941	0.822	9.49	519	.000
7	6.11	15.77	0.741	0.943	0.791	8.83	519	.000
8	6.65	16.45	0.688	0.946	0.742	9.22	519	.000
9	6.55	16.21	0.795	0.941	0.837	9.21	519	.000
10	6.77	16.78	0.803	0.940	0.846	9.2	519	.000
Total	6.69 mm	16.14 mm	Cronbach's Alpha	0.947	Explained variation 67.95 %	11.47	519	.000

Exploratory factorial analysis

Bartlett's sphericity test gave a chi-squared value of 4343.73 ($p = 0.000$, $df = 45$) and a satisfactory index of sampling adequacy (Kaiser-Meyer-Olkin) of 0.93. On the other hand, the results of the factor analysis indicated a percentage of total explained variation of 67.95%. The 10 items were grouped into one single factor, which means that all components showed coefficients above 0.74, as shown in Table 2.

Descriptive analysis of the sample

Of the students evaluated, 33% (n = 172) reported the use of inhalants in their lifetimes, with an average onset of misuse at the age 13.6 years. The substances most used were thinner and nail polish, as shown in Table 3. Among users, 40% chose only one substance consumption and 60% used two or more; 72% mentioned a usage time of less than 6 months and 60% reported a frequency of use of once a month. 35 % of the participant had made attempts to stop the use of inhalants.

In the population analyzed, we decided to divide the sample into these two groups: users and non-users. We conducted a Student´s T test for the means of each item in the ICQ test. All items showed a significant difference, as shown in Table 4.

Table 3
Percentage of mentions of volatile substances used by students

Substance	Percentage
Thinner	19
Nail polish	13
Polyvinyl chloride	11
Markers	10
Spray paints	7
Cleaning liquids	7
Paints	7
Nail polish remover	7

Table 4
Descriptive data of the two groups (Non-use of inhalants vs Inhalant use)

Ítem	Groups	Mean	SD	*t*	*gl*	*F*	*Sig.*
1	Non-use of inhalants	2.04	5.86	-12.02	518	247.10	.000
	Inhalant use	17.9	23.17	-8.84	181		
2	Non-use of inhalants	1.77	6.07	-11.24	518	241.71	.000
	Inhalant use	16.22	22.36	-8.32	183		
3	Non-use of inhalants	1.37	3.13	-11.40	518	267.74	.000
	Inhalant use	16.51	24.38	-8.11	173		
4	Non-use of inhalants	1.56	5.59	-11.47	518	276.67	.000
	Inhalant use	15.92	22.00	-8.43	182		
5	Non-use of inhalants	1.68	5.42	-12.12	518	350.21	.000
	Inhalant use	18.95	25.46	-8.80	178		
6	Non-use of inhalants	1.77	5.56	-11.16	518	292.27	.000
	Inhalant use	17.3	24.75	-8.13	179		
7	Non-use of inhalants	1.48	4.91	-10.45	518	246.72	.000
	Inhalant use	15.45	23.97	-7.57	178		
8	Non-use of inhalants	1.54	5.19	-11.21	518	312.97	.000
	Inhalant use	16.98	24.62	-8.13	178		
9	Non-use of inhalants	1.48	4.28	-11.31	518	348.72	.000
	Inhalant use	16.8	24.55	-8.12	176		
10	Non-use of inhalants	1.55	4.59	-11.24	518	338.11	.000
	Inhalant use	17.33	25.38	-8.09	176		

Table 5
Descriptive data of different age and gender groups in the population

Item	Groups	*Mean*	*SD*	*t*	*gl*	*F*	*Sig.*
1	12-14 years	7.76	16.71	0.594	518	.703	.400
	15-19 years	6.92	15.43	0.588	465		
	Men	8.4	16.78	-1.730	517	5.27	.022
	Women	5.99	14.94	-1.715	518		
2	12-14 years	7.4	16.9	1.119	518	2.12	.146
	15-19 years	5.89	14.02	1.093	435		
	Men	6.15	13.17	0.639	437	3.7	.055
	Women	7.03	17.57	0.653	518		
3	12-14 years	6.33	15.24	-0.057	518	.343	.558
	15-19 years	6.41	16.43	-0.058	501		
	Men	6.66	15.31	-0.418	490	.097	.755
	Women	6.07	16.61	-0.421	518		
4	12-14 years	7.07	16.6	1.025	518	2.37	.124
	15-19 years	5.71	13.69	1.000	433		
	Men	7.18	15.43	-1.422	518	2.54	.111
	Women	5.3	14.51	-1.415	513		
5	12-14 years	7.68	18.09	0.334	518	.195	.658
	15-19 years	7.17	16.68	0.331	465		
	Men	6.91	15.31	0.670	452	3.49	.062
	Women	7.95	19.38	0.682	518		
6	12-14 years	6.42	14.38	-0.595	518	2.84	.092
	15-19 years	7.29	18.16	-0.612	517		
	Men	7.75	17.86	-1.254	518	3.38	.066
	Women	5.94	15	-1.238	517		
7	12-14 years	7.28	18.11	1.499	518	6.87	.009
	15-19 years	5.19	13.64	1.448	407		
	Men	6.23	15.45	-0.179	498	.039	.844
	Women	5.98	16.16	-0.180	518		
8	12-14 years	7.81	18.67	1.420	518	6.34	.012
	15-19 years	5.75	14.46	1.376	415		
	Men	7.73	17.76	-1.637	518	7.33	.007
	Women	5.4	14.71	-1.614	517		
9	12-14 years	8.36	19.32	2.254	518	16.25	.000
	15-19 years	5.14	13.16	2.152	379		
	Men	6.16	14.45	0.589	455	2.94	.087
	Women	7.01	18.06	0.599	518		
10	12-14 years	8.05	18.55	1.533	518	7.75	.006
	15-19 years	5.78	15.21	1.495	432		
	Men	6.61	15.86	0.241	483	.784	.376
	Women	6.97	17.81	0.243	518		

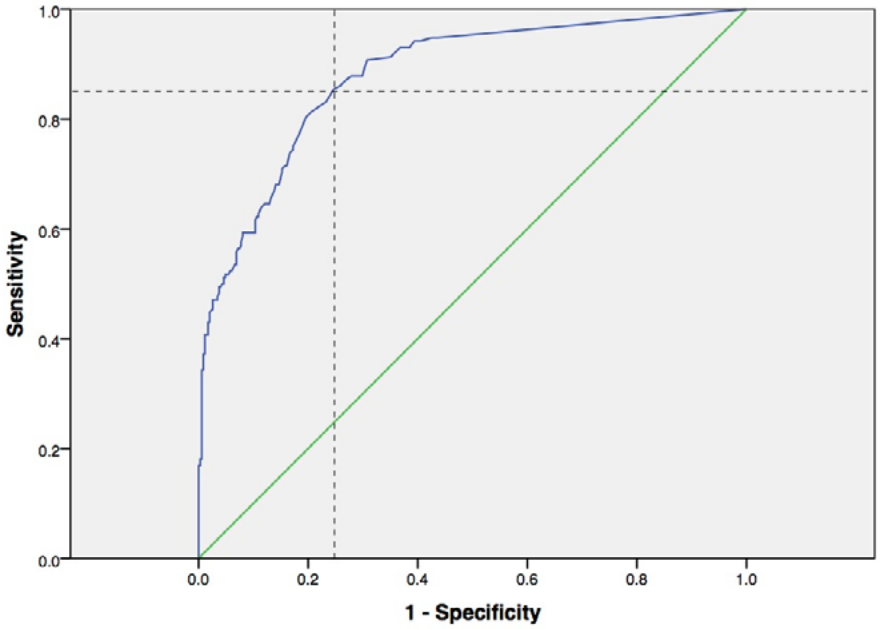

Figura 1. ROC Curve of ICQ, proposed cutoff point to differentiate the two groups (users and non-users)

A Student ´s T test was carried out for the means of each item. Table 5 shows the results of age groups and sex. For the age group, the sample was divided in two: one group aged 12-14 years (227) and the other group aged 15-19 (293). It is observed that only items 7, 8, 9 and 10 show a significant difference of ($p < 0.05$). The results of the gender group (men / women), indicate that only items 1 and 8 show a significant difference ($p < 0.05$).

ROC analysis

To assess the capability of the ICQ to discriminate users (n = 172, *M* = 169.40, *SD* = 186.48) from non-users (n = 348, *M* = 16.29, *SD* = 39.08), a ROC curve was employed, with this analysis technique, we determined ICQ sensitivity and specificity, as well as the ideal cutoff point to differentiate the two groups. The analysis showed that the breakpoint was located at 18.5 mm, with a sensitivity of 0.855 and specificity of 0.753 (1 - Specificity of 0. 247), as seen in Figure 1.

Discussion

Recent studies have revealed that the abuse of inhalants has increased in recent decades and it has become a widespread public health problem in the population. Inhalants are within the first three psychoactive substances chosen by the general population (ENA, 2011). However, there is a lack of screening instruments for the detection of craving. These instruments could be key tools in decision-making for the diagnosis and treatment of addictions (Sayette et al., 2000). Early detection of inhalants addiction may provide relevant information for prevention and treatment campaigns.

ICQ data indicated that one-third of the study population had been in contact with inhalants, and that the first use was usually at an early age (13 years old on average). These data are consistent with the literature indicating that the age of onset is between 12 and 14 years of age. Also, inhalants rank as the third preference within this population (ENA, 2011; Villatoro et al., 2012).

It is noteworthy that some studies report that misuse of inhalants is not restricted to high-risk groups (Gigengack, 2013; Villatoro et al., 2011); however, our study confirmed that misuse of inhalants is relatively common in the Mexican student population. Consumption data from our sample indicate that 46.2% of users were females and 53.8% males. Preferred substances were: paint thinners, nail polish and polyvinyl chloride (PVC). Analogous findings have been reported in previous studies in similar populations (Villatoro et al., 2005, 2012, 2013).

The distribution curve of ICQ total scores showed a shifting to higher values with an asymmetry index of 2.85 and a kurtosis of 8.69. ICQ range of total scores included values from 0 to 833 mm. Results of the ROC curve analysis indicated that the questionnaire is suitable for assessment of craving severity, This instrument not only has the ability to discriminate, but it also shows good specificity and sensitivity, starting from a general average of the ten items of 18.5 mm. In the questionnaire, zero value means the absence of craving and a value of 18.5 mm marks the starting point for the presence of this phenomenon.

ICQ data were consistent with those shown by other instruments commonly used in the clinical setting for assessing the presence or absence of psychiatric disorders. For example, in the Beck Depression Inventory, zero represents the absence of significant clinical symptoms whereas a total larger than eighteen in adults and ten in adolescents suggests the presence of depression, and even larger scores represent more severe levels (Sanz, Perdigón & Vázquez, 2003; Beck, Steer & Garbin, 1988).

The reliability analysis showed that the scores had a Cronbach's alpha of 0.947, which means that the ICQ has high internal consistency, a desirable feature for clinical purposes (Cicchetti, 1994). Moreover, this result is also consistent with other scales in Spanish that measure craving for psychoactive substances such as cocaine and alcohol. For instance, the CCQ-G, which has an alpha of 0.87 (Marín-Navarrete et al., 2011), the CCQ-N-10, which has an alpha value of 0.95 (Castillo, Albet, Jimenez-Lerma & Landabaso, 2009), and the Desire to Drink Alcohol Scale (DDS) with an alpha of 0.91 (Gan, Sanz, Valladolid & Calvo, 2006).

With regard to evidence of internal structure, factor analysis revealed that ICQ scores had a one-factor structure, which explains 67.9% of the variance. This means that this questionnaire measures the craving construct as a single phenomenon. This result is consistent with other studies, such as the one on cocaine craving (Durán & Becoña, 2006). On the other hand, this outcome contravenes other instruments that show a multidimensional measure of the theoretical components of craving (Tiffany, Carter & Singleton, 2000; Tiffany & Conklin, 2000).

ICQ also showed face validity as evaluated by a group of experts in the addiction field. Experts were asked to consider whether completeness, semantics, and sentence structure of the items guaranteed ICQ conceptual representation. The evaluation gave an average score of 3.8, which meant that the experts agreed with the items.

Other evidence supporting the validity of the ICQ instruments is the difference in total scores between groups; age and sex did not show differences, but consumption is a significant indicator, as shown by the groups (non-users and users). In this analysis, differences in scores for each item and totals were observed. The results suggest that the non-users reported significantly lower values of craving intensity as compared with those who had used inhalants. Thus, ICQ appears to provide quick and reliable information for the presence of craving for inhalants in different populations.

Implementation of the ICQ is simple and quick. Furthermore, since it is a self-report instrument, it may be used in different care centers. It also avoids the subjective perception of the clinician.

Visual analog scales such as the ICQ are common instruments for measuring craving (Sánchez-Hervás, Molina, Del Olmo, Tomás & Morales, 2001; Marín-Navarrete et al., 2011 Serecigni Guardia et al., 2004), because given their characteristics, they are useful in evaluating specific populations, such as the poorly educated and those with some cognitive impairment, as is the case of inhalant users (Castillo & Bilbao, 2008). These characteristics suggest that the ICQ may become an attractive tool in the clinical setting for the assessment of craving in inhalant users.

Our results suggest that the ten items of the ICQ instrument provide a valid global measure of the intensity of craving for inhalants. The ICQ has adequate psychometric properties and may be used in assessing craving in clinical and epidemiological settings (Iraurgi & Corcuera, 2008).

This study, although useful, is not without limitations. First, it is a cross-sectional study, which means that we cannot conclude causality or evaluate predictive validity. It is necessary to continue doing longitudinal research to compare the results and better understand the issues involved in them. On the other hand, the self-administered questionnaires may have some limitations. Further research should incorporate other diagnostic instruments, preferably objective measures, in order to evaluate concurrent validity.

Among the issues that remain to be assessed is application of the instrument in addicted populations, for the purpose of calculating the sensitivity and estimated cutoff of the intensity of craving and also to define the score to be considered clinically significant for the presence of craving. Additionally, it would be interesting to make evaluations comparing addicted populations with other tests for evaluating craving for the same and other substances. It will also be interesting to get the performance in different age groups and with comorbid personality disorders.

In conclusion, it should be noted that this research certainly opens the possibility of conducting future studies to analyze craving for inhalants. As is well known, inhalant misuse is a growing problem with an increasing proportion of persons at risk that require improved and more sustainable prevention efforts (Medina-Mora & Real, 2013).

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Conflict of interest

All authors declare no conflict of interests.

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