Original

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Clinical and behavioral profile of young inhalant users

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Introduction. Currently, misuse inhalants is increasing: addictive potential has been demonstrated in several studies. Until now there was no quantifiable clinical evidence of behavioral characteristics inhalant users. Main objective was to evaluate craving, impulsivity, frontalized behaviors and recognition of emotions in young inhalant users.

Method. Eleven male, aged 15-22 years (17.73±2.14), schooling 3-12 years (8.18±2.56) were evaluated.

Results. Evaluation showed that inhalant users exhibit signs of craving, high ranges of impulsivity, frontal behavioral deficits and difficulties detection of emotional expressions. Conclusions. In inhalants addiction, symptoms of craving and behavioral alterations are exhibited, time use increases frontal behaviors.

Keywords: Inhalants, Craving, Addiction, Adolescent, Clinical Assessment

Introducción. En la actualidad el uso indebido de inhalables está aumentando: el potencial adictivo se ha demostrado en diversos estudios. Hasta ahora no había evidencia clínica cuantificable de las características conductuales de los usuarios de inhalables. El objetivo principal fue evaluar el craving, la impulsividad, los comportamientos frontalizados y el reconocimiento de emociones en jóvenes usuarios de inhalables.

Método. Fueron evaluados once varones, edades entre 15-22 años (17,3±2,14), escolaridad entre 3-12 años (8,18±2,56).

Resultados. La evaluación evidenció que los usuarios de inhalables exhiben indicios de craving, rangos elevados de impulsividad, déficits comportamentales del sistema frontal y dificultades para la detección de expresiones emocionales.

Conclusión. En la adicción a inhalables se exhiben síntomas de *craving* y alteraciones comportamentales, el tiempo de uso incrementa los comportamientos frontales.

Palabras clave: Inhalables, Craving, Adicción, Adolescentes, Evaluación Clínica
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Perfil clínico y conductual de jóvenes usuarios de inhalables

INTRODUCTION

Inhalants are volatile substances (gases or vapors), with different chemical structures[1], that evaporate rapidly at room temperature, and are used with purposes of intoxication. They are self-administered through the nose or mouth and induce a mind-altering effect[2]. These substances are contained in several commonly used products use in households and thus widely available, legal, and relatively inexpensive[3].

The voluntary inhalation of this substances can cause serious harm to the Central Nervous System and disrupt normal trajectories of psychological, emotional and neurobiological development[4,5]. Inhalant use is a relatively common problem among children and adolescents[6]. Also observed is marked variability in the type of volatile substances abused and the pattern of consumption in each country[7-9]. The Na-

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tional Addiction Surveys in countries such as Australia, United States, Canada and Mexico indicated high rates of experimental inhalant use during early adolescence[10-13].

In Mexico the prevalence of inhalant misuse in recent years has changed, and now the volatile substances are the second drug of choice in high school students, with a prevalence of 9.7% in males and 10.3% in females[14-16] and third choice of drugs in the general population in accordance with ENA, 2011.

Cruz, 2011 mentioned that this products they have diverse chemical structures, there are different names for a single compound, the most studied is toluene. Immediate effects of solvents in low concentrations are euphoria and excitation, these similar to the early stages of alcohol intoxication, this are caused by the suppression of inhibitory brain functions. At higher concentrations, inhibition occurs in the nervous system in general, this generates depressive effects. Bowen, Ludman and others refer that chronic inhalant use is associated with several medical consequences; the most commonly are neurotoxicity and psychiatric issues[17]. Users show peripheral neuropathy, cerebellar dysfunction, cortical atrophy and encephalopathy[18-20], cognitive dysfunction (e.g. attention problems, learning and memory, psychomotor function, executive functions, and speed of information processing) and comorbidity with mental health disorders such as antisocial behavior, anxiety, major depression and polydrug use[21,22]. Agree with National Institute on Drug Abuse (NIDA) the long-term use is linked to social destructive effects and poor academic performance, and it always requires the support of medical professionals.

Adolescence is a developmental period during which there is an increased drive for independence and risky decision-making frequently leading to experimentation with drugs of abuse[23]. The fact that drugs of abuse during this period is concurrent with the critical period of continued structural remodeling an refinement of prefrontal cortex circuitry (PFC) has led to the idea that adolescent exposure may alter PFC development and disrupt behavioral control and decision making in adulthood[24].

Addiction is a chronic disease, characterized by drug intoxication, craving, binging, and withdrawal, with loss of control over drug-related behaviors[25]. The craving is a strong desire or compulsion to take drugs, immediately after withdrawal[26,27]. This is 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[28-30].

There are different studies that suggest a relationship between frontal symptoms and substance addiction. These indicate that subjects who initiate treatment of detoxification to psychoactive substances present frontal symptomatology, prior to consumption[31]. These deficits translate into maladaptive behaviors in everyday life[32-34].

The studies demonstrate that dependence on inhalants is a real phenomenon[35,36] so far there has been no clinical measurable evidence that describes issues such as craving, impulsiveness, and recognition of emotions and among other behavioral manifestations in inhalant users. It is important, because knowing the clinical characteristics of the inhalant consumers allows to optimize the diagnosis and the treatments. Therefore, the main objective of this study was to evaluate the craving, impulsivity, frontal behavior and the recognition of emotions in a sample of users of inhalants in Mexico. We hypothesized that the inhalant users would present clinical data of craving and frontal symptoms.

METHOD

Participants

Eighteen participants were recruited as part of a main inhalant addiction project. For this study was excluded seven participant because they did not complete the evaluation. Final sample size for the clinical analysis was eleven male participants inhalant-dependent (mean age of 17.73±2.14) according to criteria from the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV).

Participants were invited by medical staff center addiction treatment. Selection criteria were: a) diagnosed in accordance with DSM-IV criteria for inhalable substance dependence, b) absence of documented comorbid mood or personality disorders, c) absence of documented head injury or neurological disorders, d) indistinct sex, e) between 15 to 25 years, f) interned and in detoxification treatment and g) minimum abstinence of 21 days before testing to exclude possible interference of the substance or withdrawal symptoms. Urine analysis for the presence of drugs before the clinical assessment.

Study was approved by local ethics and research committees National Institute of Psychiatry Ramón de la Fuente Muñiz, was carried out according to Declaration of Helsinki. All participants, parents or legal guardians (in the case minors) were informed about purpose of study, they accepted to be part of study explained and provided verbal and written informed consent.

Procedure

Evaluations were performed individually and the battery was administered in a quiet room, during a session with an approximate duration of 60 minutes.

First part of the session was the explanation and signature of the informed consent, then the semi-structured interview was administered for information was collected sociodemography and consumption history. Finally, the clinical instruments were applied. Tests were administered in a fixed order, on paper and with pencil.

Instrument

- *Inhalant Craving Questionnaire (ICQ)*[37]. It is a self-administered instrument, with a Cronbach's Alpha=0.947 and the breakpoint for craving that starts from at 18.5 mm. Has two sections. The first requests information about drug-use history and second has ten statements indicating different conditions, each one has to be answered in a visual analog scale (VAS) of a 100 millimeter line, without divisions. 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 participants is measured and recorded in millimeters (mm). In Mexico this scale has been validated in adolescents and adults.
- *Plutchik's Impulsivity Scale (IS)*[38,39]. Spanish version, with internal consistency through Cronbach's Alpha of 0.713. It´s a questionnaire having 15 Likert type items with 4 possible answers (never, sometimes, often, almost always), scored respectively from 0 to 3. Has four subscales (self-control, planning, physiological behavior, spontaneous action). In Mexico it has been used for clinical populations.
- *Frontal Systems Behavior Scale (FRSBE)*[40-41]. It is a scale for evaluating various behavioral problems associated with prefrontal brain damage. It consists of 46 items divided into three subscales associated with the functioning of three brain circuits: the anterior cingulate cortex (apathy subscale), the orbitofrontal cortex (disinhibition subscale) and the dorsolateral prefrontal cortex (executive dysfunction subscale). The Spanish version has shown an adequate construct validity and an internal consistency as measured by the Cronbach's Alpha of 0.93.
- *Reading Mind in the Eyes Test (RMET)*[42,43]. During the task, the participant is presented with an image of a pair of eyes and four single-word descriptors. The respondent has to choose the word that best represents the state of the person whose eyes are shown in the image. The options relate to the emotions and intentions of the target person, so it is presumed that the RMET measures mind reading abilities. Spanish version of this scale has been widely used in research in the clinical population.

Data analysis

Descriptive analysis was applied to sociodemographic characteristics and history of consume. Non-parametric statistics were used, categorical variables were compared using the Chi-square test and continuous data were tested using the Kolmogorov-Smirnov.

Student t test was used to explore the differences between the clinical variables and the normalized performance of each test. Correlations to identify significant factors was performed between sociodemographic variables, consumption history and test scores

Data were analysed using the Statistical Package for the Social Sciences (SPSS/PC; version 20.0) and tests were considered bilaterally with significance set at $p<0.05$.

RESULTS

Descriptive analysis of the sample

Seven participants (63.6%) were under 18 years old at the time of the evaluation, with a minimum age of 15 and a maximum of 22 years, with a level of education between 3 to 12 years. All participants reported onset of consumption of inhalants before age of 18, with minimum age of 12 and maximum of 17 years. User time between 1 to 6 years. 81% (n=9) with attempts to stop using drugs ranging from1 to 6 times (Table 1).

All subjects consumed polyvinyl chloride (PVC) and combined it with other substances as the thinner and spray paints. Almost half of the subjects consumed two or more substances. More than 50% of the participants consumed daily. All participants came to treatment at some point during addiction (Table 1).

Descriptive data of scores of the assessment clinical

Results showed significant differences between clinical scores and normalized data.

ICQ showed a minimum score of 32 mm and a maximum of 560 mm, average was 249.18 ± 204.20 mm. According to normative data of test, scores higher than 18.5 mm indicate presence of craving (Table 2).

Table 1 **Sociodemographic characteristics and history volatile substance use (Frequencies, percentage, mean, standard error, Kolmogorov-Smirnov Test and Chi Square).**

Variables	N=11 (mean±SD)	(n, %)	Test statistics		
			KS	Sig	X^2
Age	17.73±2.14		0.892	0.404	
Education	8.18±2.56		0.559	0.906	0.727
Elementary school		3 (27.3)			
Middle school		5 (45.5)			
High school		3 (27.3)			
Onset age of consumption	14.64±1.36		0.801	0.542	
Time drug use	3.09±1.57		0.584	0.885	
Type of substance					
Polyvinyl chloride		11 (100)			
Thinner		3 (27.3)			
Spray paints		2 (18.2)			
Glue		1 (9.1)			
Compressed air		1 (9.1)			
Number of substance	1.73±0.905			0.307	2.364
One		6 (54.5)			
Two		2 (18.2)			
Three		3 (27.3)			
Frequency				0.307	2.364
Two days a week		3 (27.3)			
Each 15 days		2 (18.2)			
Daily		6 (54.5)			
Attempts to stop using drug				0.529	1.273
1-3 times		5 (45.5)			
4-6 times		4 (36.4)			
7 or more times		2 (18.2)			

Impulsivity test had a minimum total score of 13 and a maximum of 28, average was 16.51. All factors of this test are above normalized score, which clinically translates into problems for self-control, planning, dysfunction in physiological behaviors and spontaneous action (Table 2).

In frontal behavior scale, all scores were above normal ranges (Table 2). Consumption time has a positive correlation with total frontal behavior scores, especially in disinhibition subscale (Table 3).

Emotional perception evaluated with RMET test showed statistically significant data, total score is below normal parameter. These results suggest deficits for detection of facial emotional reactions (Table 2).

Table 2 Descriptive data of clinical caracteristics and their comparisons with standardized scores (mean, standard error, Kolmogorov-Smirnov Test and one sample T-Test)

	Normal score	N=11 (mean±SD)	Test statistics			
			KS	Sig	T	Sig
ICQ						
Total craving**	18.5 mm	294.18±204.20	0.559	0.914	4.47	0.001
IS						
Self-control**	3.41	10.36±2.65	0.564	0.908	-8.26	0.001
Planning**	1.01	5.18±2.13	0.641	0.805	-8.36	0.001
Physiological behavior**	1.6	2.36±1.20	0.487	0.972	-24.49	0.001
Spontaneous action**	1.06	4.73±1.84	0.625	0.829	-6.73	0.001
Total impulsivity**	16.51	22.64±4.31	0.566	0.906	4.70	0.001
FRSBE						
Executive dysfunction**	39	46.36±6.15	0.413	0.996	3.96	0.003
Disinhibition**	36	41.27±5.81	0.919	0.367	3.00	0.013
Apathy**	33	37.73±6.38	0.592	0.874	2.45	0.034
Total frontal behavior**	105	125.36±13.04	0.616	0.843	5.17	0.001
RMET						
Positive		4.73±1.84	0.948	0.330	-1.02	0.332
Negative		5.45±2.25	0.489	0.971	-1.68	0.123
Neutro		10.27±1.55	0.823	0.508	1.64	0.131
Total*	23	20.45±3.64	0.402	0.997	-2.31	0.043

Detailed only for contrasts that have proved significant; *p<0.05; **p<0.001

DISCUSSION

Nowadays, dependence on inhalable substances is a public health problema[44]. According to ENA 2011 age of onset is early between 12 and 14 years, these data are disturbing because use drugs during adolescence can trigger an addictive disorder[45]. In users inhalants detection of clinical characteristics and behavioral in this period of life is essential for diagnosis and design prevention and treatment programs[46].

According to results, users of volatile substances presented craving, users of volatile substances presented craving, this data is relevant because phenomenon appetite focuses on subjective impulses that lead to behaviors related to use[47], additionally to being an indicator of relapses after treatments[48,49]. Studies carried out with analogous substances, such as ethanol, showed that craving reductions are associated with abstinence[50] and in relapses scores increase significantly[51].

On the other hand, young users of inhalants with an average age of 17.73±2.14 years and a relatively short consumption time of 3.09±1.57 years, had scores above normal ranges, which clinically manifests in impulsivity, executive dysfunction, disinhibition, apathy and difficulties for emotional detection. These findings coincide in part with those reported in cognitive and behavioral studies conducted in users of various drugs, however consumption time referred to in studies is longer in comparison with inhalants users although with similar clinical manifestations. For example, there are neurocognitive[52] and behavioral deficits in alcohol

Table 3 Correlations (N=11)

	Education (years)	Number of substance	Age	Consumption time
ICQ				
Total craving*	0.616	-	-	-
IS				
Self-control**	0.749	-	-	-
Planning**	-	-0.789	-	-
FRSBE				
Disinhibition*	-	-	0.707	0.668
Total behavior frontal**	-	-	-	0.768
RMET				
Neutro**	0.846	-	-	-

Detailed only for contrasts that have proved significant; *p< 0.05; **p < 0.001

addiction[53], repeated exposure in adolescence causes alterations in executive functioning that manifests itself behaviorally in adulthood[54].

In case dependence to psychostimulants there are high impulsiveness scores, deficits in inhibitory control and cognitive flexibility[55]. Studies in polyconsumers show high scores in frontal type behaviors, particularly disinhibition[56].

General analysis showed that volatile substances addiction, craving is present, there are early alterations behavioral that are exacerbated in accordance with time consumption and number substances used. These findings are important because high levels craving and impulsiveness are associated with permanence of addictive disorders[57], also there is evidence that frontalized behaviors generate significant deterioration in social and labor functioning[58].

Although in this study population there are premorbid differences including age[59], education and sex[60] these could at some time influence maintenance of inhalants addiction.

It is important to note that these findings coincide with the studies that point that addictive disorders association with elevated levels craving and high traits of impulsivity. Craving is a crucial role both in the transition from controlled drinking to and in the mechanism underlying relapse and traits of impulsivity can favor consumption and as a consequence the relapse[57].

Also significant deficits were observed for the overall performance of RMET. These findings indicate that inhalers may present difficulties for emotional detection, what can cause less attentive to negative social stimuli such as punishment, perhaps for this reason do not give importance to the destructive effects of the drug.

Based on this the results obtained in present study are consistent with the literature, it is shown that consumers of inhalants as well as other addicts have a wide range of behavioral problems associated with alterations of the frontal system, which generates an significant deterioration in social and occupational functioning[58]. Although not forget that these alterations may not only be associated with dependence, but also with problems in real life ambit, therefore, it is required continue to investigate to what extent these deficits are the product of the chronic use of inhalants or premorbid differences in education, culture and age[59].

Finally, this cross-sectional study is relevant and useful, but not without limitations. It is important to continue doing research to check dynamics of clinical manifestations over time, this requires larger samples, also it would be interesting to make comparisons at different ages and with dual pathology. Without a doubt, this preliminary study provides guidelines for clinical and behavioral profile inhalants users to favored preventive intervention[61].

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CONFLICT OF INTEREST

All authors declare no conflict of interests.

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