

## Inhalant Dependence: Data from a Tertiary Care Center in South India

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### ABSTRACT

**Background:** This study aims to understand the sociodemographic and clinical profile of inhalant abusers seeking treatment from a tertiary care psychiatric hospital in South India. **Materials and Methods:** The clinical charts of patients who utilized the psychiatric services of a tertiary care center in India for over 10 years were examined for the study. **Results:** The sample had an urban predominance, was mostly unemployed, and was all male. Most of them had an adolescent age of onset of inhalant use (mean — 16.23 years). All patients reported the use of volatile solvents as inhalants. One other substance dependence was identified in more than half of the sample. The psychiatric comorbidity included psychosis and depression. A comparison was made between patients who presented with inhalant dependence only (I) and inhalant-dependent individuals who also used other psychoactive substances apart from nicotine (IP). The inhalant-only group (I) had an earlier mean age at onset of substance use as compared to the IP group. All patients in the I group reported withdrawal symptoms compared to 77% of patients in the (IP) group ( $P=0.048$ ). The IP group reported a significantly higher occurrence of aggression (54.5 vs. 19%,  $P=0.02$ ), externalizing symptoms (77.3 vs. 42.9%,  $P=0.03$ ), and attention-deficit hyperactivity disorder (ADHD) (50 vs. 14.3%,  $P=0.02$ ). **Conclusion:** Inhalant dependence is a serious health problem in adolescent subjects and is associated with high comorbidity of other substance dependence, psychiatric disorder, and externalizing spectrum disorder. There is a need for community-based prospective studies in this area from India.

**Key words:** Comorbidity, externalizing symptoms, inhalant abuse, substance dependence, volatile solvents

### INTRODUCTION

Inhalants are defined as substances that are volatile at room temperature. They are not already defined as a pharmacologically distinct class such as cocaine or nicotine. They are abused by inhaling through the nose and mouth like sniffing, snorting, bagging (inhaling from a bag containing the substance), huffing (inhaling through the mouth from a rag saturated with the

substance) or by spraying into the mouth. In general, inhalants are divided into volatile solvents, nitrous oxide, and nitrites. The common substances used as inhalants are paint thinners, typewriter correction fluids, glue, gasoline, adhesives, varnishes, deodorants, and so forth. Volatile solvents are the largest and the most diverse group of abused inhalants. This group includes chemicals like toluene (adhesives, spray paint), butane, propane (paint, deodorant), 1-1-trichloroethane (cleaning agents and correction fluid), and aliphatic and aromatic hydrocarbons (gasoline, petrol). Volatile substances reach the brain rapidly because of the quick absorption from the pulmonary circulation and high amount of lipid solubility. The chemical vapors in inhalants have the ability to alter one's level of consciousness. The mechanism of action of inhalants is still unclear; fluidization of neuronal membranes, potentiation of the gamma-aminobutyric acid (GABA)

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receptor, and hyperpolarization and action on glutamate receptors are some of the proposed hypotheses.<sup>[1]</sup>

Inhalant abuse could either be independent or a part of polysubstance dependence.<sup>[2]</sup> Inhalant use is a problem encountered predominantly in street children, adolescents, and youth<sup>[3,4]</sup> and this has been recognized as a growing health problem in this group. Inhalant abuse as a significant health concern has been reported from many countries across the globe.<sup>[5-9]</sup> The rate of young people having a lifetime use of inhalants has been surveyed in western countries. Beauvais and Oetting<sup>[10]</sup> report prevalence rates of 5 to 15% in the United States, and Smart<sup>[11]</sup> reports a prevalence of 3 to 6% in Canada. Lack of screening could be the reason why this remains a hidden concern in many countries.<sup>[12]</sup> Among life-time inhalant users, 46.9% met the criteria for a life-time DSM-IV diagnosis of dependence in a recent study.<sup>[13]</sup> The literature from India is very sparse and limited to only a few case reports or case series.<sup>[14-17]</sup> A recent clinic-based study from a tertiary care center in North India<sup>[18]</sup> reported that a typical case profile of inhalant abusers was an unmarried male, mean age of 19 years, unemployed or students, urban, nuclear family, middle socioeconomic status, and poor social support. Inhalant dependence was identified in 81%. Inhalant use as the only substance of abuse was detected in 33%.

This study aims to understand the sociodemographic and clinical profile of inhalant abusers seeking treatment from a tertiary care psychiatric hospital in South India.

## MATERIALS AND METHODS

We reviewed the clinical case records of patients who utilized the psychiatric services of the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, India, during the period January 1999 to December 2009 (10 years). We identified the subjects with a diagnosis of 'Mental and behavioral disturbances due to use of volatile solvents' (F18) (inhalant dependence) according to ICD 10 classification of Mental and Behavioral Disorders. There were 43 patients who had a diagnosis mentioned as per ICD 10. The dependence of other substances, if present, was also coded in the files along with inhalant dependence. NIMHANS is a premier psychiatric institute and tertiary care center in South India. It has a 650-bed hospital with both Outpatient and Inpatient Services. Detailed evaluation of all admitted patients is done, including complete history, physical, and neurological examinations, mental status examination, and the basic laboratory examinations. All the patients are discussed with the senior residents. Finally, all the cases are evaluated and reviewed by at least two qualified psychiatrists. The records of

these patients were reviewed in detail for the study by three investigators (JN, BV, and MR). The charts were discussed with the third investigator (KM), subsequently.

### Statistical analysis

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 13.0 (SPSS Inc., Chicago, IL, USA). The basic frequencies were calculated with mean, standard deviation, and percentages. The independent sample t test and the Chi-square / Fisher's exact test were used for comparison of continuous and categorical variables, respectively.

## RESULTS

The mean age of the individuals at presentation was 19.26 years (SD-3.74). Most of them had an adolescent age of onset of inhalant use (mean — 16.23 years). The sample was entirely composed of single males. The majority were educated only up to upper primary class level. There was an urban predominance in the sample (97%) and nearly 60% of the individuals were unemployed. There was an average of nearly three years before treatment seeking. The salient features in the sociodemographic profile of the patients are shown in Table 1.

The most commonly reported reason for initiation was peer pressure followed by 'curiosity'. All patients reported the use of volatile solvents as inhalants and the use of nitrites / nitrous oxide was unreported in the present sample. The most common compounds inhaled were 1-1-trichloroethane, toluene, and aromatic hydrocarbons. Huffing was the most common mode of use followed by sniffing. A majority of the subjects clearly reported withdrawal symptoms on stopping inhalant use. Craving, tolerance, and salience were the other features of dependence reported. Euphoria was the most commonly experienced acute effect of inhalant use as reported by the patients. The pattern and features of inhalant abuse are shown in Table 2.

**Table 1: Sociodemographic features**

	Mean (SD)
Age of the person (years)	19.26 (3.7)
Age of onset of use of inhalant (years)	16.23 (3.8)
Years of education	7.65 (3.9)
	N (%)
Urban background	42 (97.7)
Occupation	
Manual labor	6 (14.0)
Skilled labor	3 (7.0)
Semiskilled labor	2 (4.7)
Business	2 (4.7)
No occupation	30 (69.8)
Family history of substance dependence	8 (18.6)

The comorbid conditions are listed in Table 3. One other substance dependence was identified in more than half of the sample. The dependence on other substances in decreasing order of frequency was benzodiazepine, nicotine, cannabis, and opioid. The psychiatric comorbidity included psychosis and depression. Nearly 37% of the patients were brought for psychiatric evaluation, with aggression as the presenting symptom. Externalizing symptoms like impulsivity, inattention, hyperactivity, and conduct symptoms were identified in a significant proportion (60%) of the cases.

A comparison was made between patients who presented with inhalant dependence only (I) and inhalant dependent individuals who also used other psychoactive substances, apart from nicotine (IP).

**Table 2: Pattern and features of inhalant abuse**

	N (%)
Reasons for initiation	
Peer pressure	37 (86.0)
Self experimentation	6 (14.0)
Type of material used for inhalation	
Paint thinner	1 (2.3)
Correction fluid	30 (69.8)
Petrol / diesel	2 (4.7)
Adhesive	10 (23.3)
Mode of use	
Huffing	28 (65.1)
Sniffing	15 (34.9)
Features of abuse / dependence	
Withdrawal symptoms	38 (88.4)
Craving	42 (97.7)
Tolerance	39 (90.7)
Acute effects of using inhalants	
Sneeze / cough	1 (2.3)
Excess salivation	2 (4.7)
Conjunctival congestion	1 (2.3)
Euphoria	35 (81.4)
Pleasurable hallucinations	4 (9.3)

**Table 3: Comorbid conditions**

	N (%)
Use of any other substance	22 (51.2)
Alcohol dependence	6 (14.0)
Nicotine dependence	17 (39.5)
Cannabis dependence	9 (20.9)
Opioid dependence (dextromethorphan)	2 (4.7)
Benzodiazepine dependence	19 (44.2)
Other comorbid psychiatric conditions	
Psychosis	16 (37.2)
Depression	4 (9.3)
Other clinical features	
Aggression	16 (37.2)
Dissocial traits	9 (20.9)
Externalizing symptoms	26 (60.5)
Subnormal intelligence	7 (16.3)

The inhalant only group (I) had an earlier mean age at onset of substance use as compared to the IP group. All patients in the I group reported withdrawal symptoms, compared to 77% of patients in the IP group ( $P=0.048$ ). The IP group reported significantly higher occurrence of aggression (54.5 vs. 19%,  $P=0.02$ ), externalizing symptoms (77.3 vs. 42.9%,  $P=0.03$ ), and ADHD (50 vs. 14.3%,  $P=0.02$ ).

## DISCUSSION

### Sociodemographic profile

There were only 43 patients who were brought for medical / psychiatric care over the 10 years, for problems related to inhalant abuse. Of these, only 21 had a primary inhalant use disorder. This shows that inhalant abuse remains a hidden problem in the community. Community studies have found that this is a major problem in the low socioeconomic class, urban background, school-going children, and in street children.<sup>[4,19]</sup> Therefore, what reaches a tertiary care psychiatric center is only the tip of the iceberg.

All the patients in the study were males. This could indicate that males are more prone to inhalant abuse when compared to females. This reflects the results of another clinic-based study from India.<sup>[18]</sup> Inhalant abuse and dependence were reported to affect adolescents regardless of gender, age, and race / ethnicity, according to data from the 2000 and 2001 National Household Surveys on Drug Abuse in the United States,<sup>[19]</sup> while in certain samples, as reported by Beauvais *et al.*,<sup>[20]</sup> there was a female preponderance. Urban predominance of the patients has been reported in the literature,<sup>[21]</sup> in certain samples. This was reported in the Indian study by Kumar *et al.*<sup>[18]</sup> Most of our cases have come from an urban background, which may be a function of either a true prevalence of inhalant dependence in the urban population or increased accessibility to treatment.

### Pattern of inhalant abuse

The main reason for initiation of solvent abuse, as reported by the adolescents, was peer pressure, followed by a tendency to experiment by oneself. These have been the main reasons mentioned in an ethnographic exploratory study from India by Seth *et al.*<sup>[22]</sup> The tendency to 'self-experiment' could also reflect novelty seeking, as a precursor to use other substances, by certain individuals. The inhalants abused were easily procurable and stationery items like correction fluid, adhesives, paint thinner, and in some cases petroleum products. These materials are low in cost, easy to obtain, and some of them are available at home for some domestic purposes. Thus, easy accessibility precedes dependence.

Craving and withdrawal symptoms reported by a majority of the patients in the sample are in concordance with the earlier reported data on features of dependence.<sup>[23]</sup> Tolerance has been demonstrated to develop with toluene within three months of regular use.<sup>[24]</sup> Withdrawal symptoms occurring with solvent dependence have been mentioned in some studies.<sup>[25,26]</sup>

### Comorbidity

Comorbidity with other substance dependence is seen in more than half of this sample. This finding is a replication of data from some previous studies from India<sup>[3,18,22]</sup> and from other parts of the world.<sup>[19,27,28]</sup> This could also indicate that inhalant abuse may be a predictor for the use of other substances in future, as reported by Dinwiddie *et al.*<sup>[29]</sup>

Individuals with inhalant dependence have been found to be associated with more impulsive and fearless temperaments and report more past-year antisocial behavior and global substance use problems.<sup>[13,30]</sup> High-risk behavior and externalizing symptoms are also associated with this condition.<sup>[4]</sup> Wu *et al.*<sup>[19]</sup> mentions that adolescents with inhalant use disorders report coexisting multiple drug abuse and dependence and delinquent behaviors. Similarly, conduct disorder has been the most common psychiatric diagnosis in the study by Kumar *et al.*<sup>[18]</sup> Some of the earlier studies have reported increased association of affective disorders in patients with inhalant use.<sup>[28,31]</sup> In this study, psychosis was also found to be associated with solvent abuse. Whether these are comorbid, independent psychotic conditions or inhalant-induced psychosis is difficult to comment. Chronic inhalation of solvents, including glue, paint thinners, and gasoline, can produce a persistent psychotic disorder, characterized by delusions and hallucinations.<sup>[32]</sup> The presence of toluene appears to play an important role in the formation of inhalant-induced psychotic symptoms.<sup>[33-35]</sup>

### Comparison of pure inhalant users and inhalant abusers with polysubstance abuse

We did a comparison between individuals with inhalant use alone (I) and individuals with inhalant use as a part of polysubstance dependence (IP) [Table 4]. A higher mean age of onset of inhalant use, more withdrawal symptoms, and a presence of aggression and externalizing symptoms demarcated the IP group from the I group. The earlier age of onset of inhalant use in the I group could be a function of easy accessibility, and at a higher age, individuals could resort to more powerful and costlier substances than inhalants. It can also be hypothesized that individuals with externalizing diathesis have more severe addiction and end up being dependent on multiple substances, explaining a higher occurrence of externalizing symptoms and aggression in the IP group.

**Table 4: Comparison of pure inhalant users (I) and inhalant abusers with polysubstance abuse (IP)**

Variable	I (n=21) Mean (SD)	IP (n=22) Mean (SD)	t	P
Age (years)	18.09 (3.89)	20.36 (3.30)	- 2.06	0.460
Age of onset of inhalant use	14.71 (4.08)	17.68 (2.93)	- 2.74	0.009
Years of education	7.04 (3.39)	8.22 (4.50)	- 0.96	0.340
Total months of use	41.14 (40.60)	34.27 (40.84)	0.55	0.583
	N (%)	N (%)	P (Fischer test)	
Urban	21 (100.0)	21 (95.50)		1.000
Withdrawal symptoms	21 (100.0)	17 (77.30)		0.048
Tolerance	20 (95.20)	19 (86.40)		0.607
Saliency	20 (95.20)	20 (90.90)		1.000
Craving	21 (100.0)	21 (95.50)		1.000
Comorbidity				
Depression	0 (0)	4 (18.20)		0.108
Psychosis	8 (38.10)	8 (36.40)		1.000
Aggression	4 (19.00)	12 (54.50)		0.027
Antisocial traits	3 (14.30)	6 (27.30)		0.457
Externalizing symptoms	9 (42.90)	17 (77.30)		0.031
Impulsivity	8 (38.10)	11 (50.00)		0.543
Attention deficit hyperactivity	3 (14.30)	11 (50.00)		0.022
Conduct symptoms	8 (38.10)	10 (45.50)		0.760

*P*<0.05 is statistically significant

This study has some limitations. This study was on treatment-seeking population, and hence, may not truly reflect the clinical profile of patients with inhalant abuse in the community. This is a retrospective chart review and the baseline diagnosis was chart based. However, this limitation was partly addressed by an independent review of all the charts, by independent investigators.

The present study provides an understanding about the profile of inhalant abusers presenting to a clinic. It shows that inhalant dependence is a serious health problem in adolescent subjects and is associated with higher comorbidity of other substance dependence, psychiatric disorder, and externalizing spectrum disorder. It is important for clinicians to be more sensitive to the problem of inhalant use and routinely enquire about the same, at least in patients with polysubstance, in order to detect and treat this largely undetected clinical problem. The need of the hour is to conduct more community-based studies to identify the magnitude of this health hazard and ensure treatment of affected individuals.

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