

Inhalant Use Among Incarcerated Adolescents in the United States: Prevalence, Characteristics, and Correlates of Use

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Introduction

- This presentation is based on a study using residents of 27 Missouri Division of Youth Services Facilities who completed interviews to determine patterns of inhalant use among incarcerated adolescents.
- Recommendations for future interventions and research are provided

Commonly Abused Inhalants in U.S.

- Glue
- Shoe polish
- Toluene
- Lighter fluid
- Gasoline (Wu et al., 2004)

Inhalants

- Methods of Inhaling

- Inhale vapors from a rag soaked with a substance
- Inhale vapors from a bag where a substance has been deposited

Signs of Intoxication

- Slurred speech
- Ataxia
- Stupor
- Other signs similar to alcohol intoxication

Clinical Studies on Inhalant Use

- Repeated use associated with
 - Parkinson's
 - Cerebellar
 - Ataxia
 - Encephalopathy
 - Trigeminal neuropathy
 - Hepatotoxicity
 - Heptorenal syndrome
 - Delayed neurological recovery
 - Deaths due to drug actions and accidents (e.g., Byard et al., 2006; Doring et al., 2002; Finch and Lobo, 2005; Hahn et al., 2006)

Clinical Studies on Inhalant Use Cont.

- Neurological findings
 - Cerebral atrophy
 - Thinning of the corpus callosum
 - Lesions of the pyramidal tract/cranial nerve signs (e.g., Yamanouchi et al., 1995)
- Single inhalant exposure can cause long-term learning, memory, and attentional impairments (Stollery, 1996)
- Inhalant use associated with delinquency, conduct disorder, impulse control, and anxiety disorders (e.g., Kelly et al., 2002; Sakai et al., 2004)

Adolescent Rate of Inhalant Use

- Study of 12-17 year olds in US using National Household Survey on Drug Abuse data (Wu et al., 2004)
 - 9% of 36,850 respondents reported inhalant use
 - Lifetime rates did not differ by gender or family income
 - American Indian and multiracial youth had higher rates
 - Higher rates among youth from non-metropolitan areas, polydrug users, and those with history of antisocial behavior, foster care placement or mental health treatment
- Study limitation: excluded incarcerated and institutionalized youth

Research on Incarcerated Youth and Inhalant Use

- 18% of youth in a residential/day treatment program for substance abuse and behavior disorders reported inhalant use (Sakai et al., 2004)
- Inhalant users were significantly more likely to have
 - Lifetime history of major depression (23% vs. 12%)
 - Previous suicide attempt (27% vs. 15%)
 - Conduct disorder (93% vs. 81%)
 - Other substance use disorders
 - History of neglect and physical or sexual abuse (Sakai et al., 2004)

Research on Incarcerated Youth and Inhalant Use

- McGarvey et al (1996)
 - Evaluated 619 youth in a juvenile correctional facility in Virginia
 - 14% of sample used inhalants
 - Limitations:
 - Unclear how youth were sampled
 - No refusal rate for recruitment reported
 - Inhalant use assessment limited to a few agents
 - Inhalant use assessment included agents with different profiles of effects and patterns of use (Balster, 1998)

Limitations of Research on Incarcerated Youth and Inhalant Use

- **Small sample sizes** (e.g., Jacobs and Ghodese, 1988)
- **Limited assessments of inhalant use and related psychiatric syndromes** (e.g., McGarvey et al., 1999)

Current Study Goals

1. Study epidemiology of inhalant use in a state population of incarcerated youth
2. Examine patterns of inhalant use
3. Compare lifetime inhalant users to nonusers
4. Examine factors predicting lifetime inhalant use

Study Sample

- All current MO Division of Youth Services (DYS) residents eligible
- DHS: legal guardian of residents 13-17 years assigned by the state's juvenile courts
- Representative of incarcerated youth nationally (Sickmund, 2002)
- 723 youth completed interview (97.7% of DHS residents)

Methods

- Interviews conducted by trained graduate students
- \$10 incentive provided to participants' facility monetary accounts
- Interviews conducted confidentially in large rooms with private areas

Measures

- Volatile Solvent Screening Inventory (VSSI)
- 45 minute one-on-one interview to assess:
 - Demographic characteristics
 - Medical history
 - Lifetime/annual use of 65 inhalants
 - Other drug use and substance-related problems
 - Current psychiatric symptoms
 - Thoughts of suicide/actual suicide attempts
 - Trauma history
 - Antisocial traits and criminal activity

Measures Cont.

- Comprehensive Solvent Assessment Interview (CSAI) for those reporting any inhalant use
 - Reasons for starting and stopping
 - Typical modes
 - Locations
 - Contexts and subjective effects
 - Adverse consequences/high-risk behaviors occurring in association with acute inhalant intoxication
 - Perceived risks of inhalant use
 - Estimated likelihood of future inhalant use
 - Sibling or and friend's use of inhalants
 - DSM-IV Inhalant Abuse and Dependence criteria

Data Analysis

- Bivariate and adjusted comparisons of lifetime inhalant users and nonusers
 - Chi-square and logistic regression for categorical variables
 - *t*-tests, *F*-tests, and multiple linear regression for continuous variables

Characteristics of Incarcerated Youth

Characteristics	Participants (n=723)
Average age	15.5 (SD=1.2)
Male	87%
Race	
African American	33%
Caucasian	55.4%
Latino/Latina	3.9%
Bi/Multi-Racial	7.7%
Family receiving public assistance	40.3%

Characteristics of Incarcerated Youth Cont.

Characteristics	Participants (n=723)
Prescribed Medication	
Psychotropic medication	42.3%
ADHD medication	37.2%
Antidepressants	12.4%
Mood stabilizers	12.4%
Antipsychotics	10.0%
Head injury with extended period of unconsciousness	18.3%

Lifetime Inhalant Use

Lifetime Inhalant Use	Lifetime prevalence
Any inhalant	36.9%
Number of inhalant products	
4 or more inhalants	47.9%
3 inhalants	20.2%
2 inhalants	16.1%
1 inhalants	15.7%
Mean number of inhalants used by lifetime inhalant users	4.8 (SD=4.1; median=3.0, range=1.0-24.0)
Female inhalant use	43.6%
Male inhalant use	35.9%

Use of Specific Inhalants

Inhalant product	Lifetime prevalence	Got high
Any inhalant	36.9%	
Gasoline	22.0%	81.8%
Permanent markers	14.7%	42.5%
Computer duster spray	14.7%	90.6%
Spray paint	11.5%	78.3%
Nail polish remover	8.7%	47.6%
Paint thinner	8.3%	90.0%
Air freshener	8.0%	70.7%
Correction fluid	7.2%	34.6%
Butane	6.9%	58.0%
Freon	6.1%	93.2%

Inhalants with <6% Lifetime Prevalence

- Airplane/model glue
- Rubber cement
- Hairspray
- Other glues/cements
- Paint remover/stripper
- Propane
- Deodorant spray
- Ether
- Any other cleaning agent
- Carburetor cleaner
- Car/exhaust fumes
- Aerosol glass cleaner
- Kerosene
- Lighter fluid
- Shoe shine/polish
- Dry erase markers
- Liquid paint
- Insecticide spray
- Paint pens
- PAM
- Other inhalants

Modes of Use

- More than half of all inhalants were sniffed from a container
 - Nail polish, correction fluid, gasoline, and paint pens users
- Spraying directly into nose or mouth was uncommon
 - Computer duster spray and butane
- Placing plastic bag over nose, mouth, or head was uncommon
 - Spray paint and Freon
- Saturated cloth
 - Paint thinner, air freshener, hair spray, paint remover/stripper, deodorant spray, ether, and carburetor cleaner

Addiction Liability

- 100+ lifetime days of use
 - Butane (14%)
 - Computer duster spray (13.2%)
 - Gasoline (11.9%)
 - Liquid paint (8.4%)

Addiction Liability Cont.

Less than 5 lifetime days of use

- Gun cleaning solvents (83.3%)
- Waxes (83.3%)
- Mothballs (100%)
- Cooking gases (80%)
- Any other cleaning agent (77.8%)
- Plaster and gum remover (100%)
- Insecticide spray (100%)
- Shoe shine/polish (92.3%)
- Other glues/cements (75.8%)
- Balsa wood cement (100%)

Recency of Use

Inhalant	% of lifetime users in year prior to incarceration
Any inhalant	87.3%
Gasoline	69.2%
Computer duster spray	87.6%
Permanent markers	76.4%
Spray paint	74.7%
Nail polish	72.1%
Paint thinner	86.7%
Nail polish remover	73.0%
Air freshener	72.4%

Recency of Use Cont.

Inhalant	% of lifetime users in year prior to incarceration
Correction fluid	63.5%
Hairspray	78.6%
Freon	79.5%
Butane	80.0%
Airplane/model glue	59.0%

Reasons for Starting and Stopping Inhalant Use

- **Reasons for starting**

- Curious about effects (77.2%)
- Thought it would be fun and exciting (70.4%)
- Felt bored (63.3%)
- Easier to get than other drugs (61.8%)
- Fun to use (51.0%)

- **Reasons for stopping**

- Got tired of them (56.6%)
- Felt need to change (56.2%)
- Did not like them (48.4%)

Preferred Locations of Use

Location	Prevalence
Home	35.2%
Friend's home	28.5%
Parties	15.4%
"On the street"	12.0%
"Other" places	4.9%
School grounds	4.1%

Temporal Patterns of Use

Temporal Pattern of Use	Prevalence
Weekends	39.7%
Evenings	35.2%
Immediately after school	10.9%
During school hours	10.1%
Mornings before school	4.1%

Contexts of Use

- Thought about how good a rush or high had felt (51.3%)
- Met with some friends and wanted to have good time (43.4%)
- With a group of people using inhalants (43.0%)
- With friends and wanted to increase their enjoyment (42.7%)
- Felt happy (37.4%)
- With other people and felt they were expected to join in (35.7%)
- Found inhalant or saw something that reminded them (35.2%)
- When felt overwhelmed and wanted to escape (34.1%)

Perceived Risks

- Using inhalants on 1 or 2 occasions
 - Great risk (38.6%)
 - Moderate risk (23.6%)
 - Slight risk (27.0%)
 - No risk (10.9%)
- Regular inhalant use
 - Great risk (70.4%)
 - Moderate (18.0%)
 - Slight (6.7%)
 - No risk (4.9%)

Perceived Problems with Inhalants

- Perceived Problems
 - Never experienced problems (56.9%)
 - Small problems (21.0%)
 - Moderate problems (14.6%)
 - Big problems (7.5%)
- Perceived Availability
 - Widely available (81.3%)
 - Very or fairly easy to get (12.0%)

Perceived Likelihood of Future Inhalant use

Perceived Likelihood of Future Use	Percent of Respondents
"No Chance"	72.3%
Little chance	16.9%
Even chance	7.5%
Good chance	2.6%
Certain they would use	0.7%

Peer and Sibling Inhalant Use

Peer and Sibling Use	Prevalence
Peer Use	
All of friends	3.4%
Most of friends	14.6%
Some of friends	18.9%
A few friends	36.3%
Sibling who used inhalants	20%

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Criminological Measures

Criminological Variables M ^a (SD)	Lifetime inhalant Users	Nonusers	Results
SRD (Total Delinquency)	27.8 (19.1)	22.4 (17.8)	$t(721)=-3.9, p<.001, d= -.29^b$
SRD (Property Crime Index)	16.9 (12.2)	12.3 (11.3)	$t(721)=-5.1, <.001, d= -3.8$
Age at onset of offending (years)	10.1 (2.8)	10.8 (2.9)	$t(719)=3.2, p<.01, d=.24$

^aM=Mean; SD = standard deviation; ^bd=Cohen's effect size for two independent groups computed using t -test values and associated degrees of freedom

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Health Measures Cont.

Physical and mental health N(%)	Lifetime inhalant Users	Nonusers	Results
History of head injury	64 (24.0%)	68 (15.0%)	$X^2(1)=9.0, p<.01,$ OR ^a =1.8, (1.2-2.6)
Diagnosis W/mental illness	176 (66.2%)	194 (42.7%)	$X^2(1)=36.9, p<.001,$ OR=2.6, (1.9-3.6)
Hearing voices	58 (21.7%)	48 (10.5%)	$X^2(1)=16.9, p<.001,$ OR=2.4 (1.6-3.6)

^aOR=unadjusted odds ratio with 95% confidence interval

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Mental Health Measures

Brief Symptom Inventory M (SD)	Lifetime inhalant Users	Nonusers	Results
Global Severity Index	54.6 (37.5)	37.4 (31.5)	$t(482.9)^a = -6.3, p < .001, d = -.57$
Somatization	4.5(4.7)	3.1(4.0)	$t(490.6) = -4.3, p < .001, d = -.39$
Obsessive-Compulsive	8.4(5.8)	5.5(4.8)	$t(480.5) = -6.9, p < .001, d = -.63$
Interpersonal Sensitivity	3.6(3.7)	2.5(3.1)	$t(485.6) = -4.0, p < .001, d = -.36$
Depression	6.2(5.6)	3.9(4.5)	$t(460.4) = -5.7, p < .001, d = -.53$

^aStatistical contrasts associated with fractional degrees of freedom represent cases where violations of homogeneity of variance assumptions necessitated more stringent tests for statistical significance

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Mental Health Measures Cont.

Brief Symptom Inventory M (SD)	Lifetime inhalant Users	Nonusers	Results
Anxiety	5.9 (5.3)	3.5(4.1)	$t(459.8) = -6.4, p < .001, d = -.60$
Hostility	7.0(5.1)	5.5(4.8)	$t(721) = -4.0, p < .001, d = -.30$
Phobic Anxiety	2.5(3.4)	1.7(3.0)	$t(508.3) = -3.1, p < .01, d = -.27$
Paranoid Ideation	7.2(4.7)	5.7(4.6)	$t(721) = -4.2, p < .001, d = -.31$
Psychoticism	4.7(4.4)	3.0(3.3)	$t(445.3) = -5.5, p < .001, d = -.52$

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Mental Health Measures Cont.

Psychopathic Personality Inventory M (SD)	Lifetime inhalant Users	Nonusers	Results
Total	141.5(15.1)	133.4(12.5)	$t(478.7) = -7.4, p < .001, d = -.68$
Machiavellian Egocentricity	7.9(4.4)	16.9(4.5)	$t(721) = -3.0, p < .01, d = -.22$
Carefree Nonplanfulness	15.4(3.8)	13.5(3.8)	$t(721) = -6.6, p < .001, d = -.49$
Fearlessness	19.4(4.9)	15.7(5.0)	$t(721) = -9.7, p < .01, d = -.72$

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Mental Health Measures Cont.

Psychopathic Personality Inventory M (SD)	Lifetime inhalant Users	Nonusers	Results
Blame Externalization	18.9(4.7)	17.9(4.8)	$t(721) = -2.8, p < .01, d = -.21$
Impulsive Nonconformity	16.1(4.5)	14.0(3.7)	$t(472.6) = -6.3, p < .001, d = -.58$
Stress Immunity	18.3(4.4)	19.4(4.3)	$t(721) = 3.3, p = .001, d = .25$

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Attitudinal Measures Cont.

Antisocial Process Screening Device M (SD)	Lifetime inhalant Users	Nonusers	Results
Total	17.7 (5.4)	15.4(5.4)	$t(720) = -5.5, p < .001, d = -.41$
C/U Traits	8.3(3.3)	7.3(3.0)	$t(720) = -3.9, p < .001, d = -.29$
Impulsivity	7.2(2.0)	6.1(2.1)	$t(720) = -7.3, p < .001, d = -.54$

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Attitudinal Measures Cont.

MA Youth Screening Inventory M (SD)	Lifetime inhalant Users	Nonusers	Results
Traumatic Experiences	2.6(1.4)	2.3(1.4)	$t(715) = -3.34, p < .001, d = -.25$
MAYSI-Suicide Ideation	2.9(2.1)	1.4(1.8)	$t(508.9) = -9.9, p < .001, d = -.88$

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Substance Use Measures

Substance use and related problems	Lifetime inhalant Users	Nonusers	Results
MAYSI-Alcohol/Drug Problems Scale M (SD)	5.1(2.9)	3.2(2.3)	$t(626.1) = -11.6, p < .001$ $d = -.93$
Lifetime # of drug types used M (SD)	5.9(2.9)	2.9(2.1)	$t(432.4) = -15.0, p < .001$ $d = -1.44$
Lifetime alcohol use N (%)	254(95.1%)	359(78.7%)	$\chi^2(1) = 35.1, p < .001$, OR= 5.3 (2.9–9.6)

Unadjusted Univariate Contrasts of Lifetime Inhalant Users and Nonusers Across Substance Use Measures Cont.

Substance use and related problems	Lifetime inhalant Users	Nonusers	Results
Age at onset of alcohol use (years) M (SD)	11.1(2.8)	12.0(2.6)	$t(611.1) = 3.8, p < .001, d = .31$
Lifetime marijuana use <i>N</i> (%)	255(95.5%)	371(81.4%)	$\chi^2(1) = 29.0, p < .001, OR = 4.9 (2.6-9.1)$
Age at onset of marijuana use (years) M (SD) ^a	11.0(2.4)	11.5(2.1)	$t(623.2) = 3.1, p < .01, d = .25$

^aLifetime inhalant users had significantly higher rates of kidney disease and hormonal disorders, and an earlier mean age at onset of contact with police

Multiple Logistic Regression Examining Race of Lifetime Inhalant Use in Total Sample of Inhalant Users and Nonusers

Race	b	S.E.	Wald	<i>p</i>	Odds Ratio	95.0% CI(OR)
African American	22.2	1.0				
Caucasian	1.2	.35	12.6	<.001	3.4	(1.7-6.7)
Latino/Latina	2.4	.57	18.0	<.001	11.2	(3.7-34.1)
Bi/Multiracial	.94	.46	4.2	<.05	2.6	(1.0-6.3)

Multiple Logistic Regression Examining Geographic Area of Residence of Lifetime Inhalant Use in Total Sample of Inhalant Users and Nonusers

Geographic Area of Residence Variable	b	S.E.	Wald	<i>p</i>	Odds Ratio	95.0% CI(OR)
Urban			15.9	1.0		
Suburban	-.46	.36	1.7	.20	.63	(.31-1.3)
Small town	.70	.27	6.8	<.01	2.0	(1.2-3.4)
Rural	-.01	.42	.00	.99	.99	(.43-2.3)
Gender	-.43	.33	1.7	.19	.65	(.34-1.2)
SRD-Property Crime Index	.01	.01	1.1	.29	1.0	(.99-1.0) ^a
Age at Onset of Offending	.01	.04	.08	.78	1.0	(.94-1.1) ^a

^aContinuous variable

Multiple Logistic Regression Examining History of Lifetime Inhalant Use in Total Sample of Inhalant Users and Nonusers

History	b	S.E.	Wald	<i>p</i>	Odds Ratio	95.0% CI(OR)
Head injury	-.11	.29	.15	.70	.90	(.51-1.6)
Kidney disease	1.9	1.9	.95	.33	6.4	(.15-262.9)
Hormonal disorders	1.4	1.0	2.0	.16	4.2	(.56-30.6)
Mental illness	.19	.23	.70	.40	1.2	(.77-1.9)
BSI-Global Severity Index	.00	.00	.56	.45	1.0	(.99-1.0) ^a

^aContinuous variable

Multiple Logistic Regression Examining PPI^a of Lifetime Inhalant Use in Total Sample of Inhalant Users and Nonusers

PPI	b	S.E.	Wald	<i>p</i>	Odds Ratio	95.0% CI(OR)
Fearlessness	.09	.02	14.0	<.001	1.1	(1.0-1.1) ^b
Carefree Nonplanfulness	.05	.03	2.4	.12	1.1	(.99-1.1) ^b
Impulsive Nonconformity	.03	.03	1.2	.28	1.0	(.97-1.1) ^b

^a Psychopathic Personality Inventory; ^bContinuous variable

Multiple Logistic Regression Examining APSD^a of Lifetime Inhalant Use in Total Sample of Inhalant Users and Nonusers

APSD	b	S.E.	Wald	p	Odds Ratio	95.0% CI(OR)
Callous/Unemotional	.00	.04	.00	.99	1.0	(.92-1.1) ^b
Impulsivity	-.08	.07	1.4	.24	.92	(.81-1.1) ^b
MAYSI ^b Suicide Ideation Index-2	.18	.05	11.8	=.001	1.2	(1.1-1.3) ^b
MAYSI ^b 2 Traumatic Experience Index	-.10	.08	1.5	.23	.91	(.78-1.1) ^b
MAYSI ^b 2 Alcohol/Drug use Index	.03	.02	1.8	.18	1.0	(.99-1.1) ^b
Total # drug types used	.37	.05	57.3	<.001	1.4	(1.3-1.6) ^b

^aAntisocial Process Screening Device; ^bMA Youth Screening Instrument
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Characteristics of Inhalant Use

- Study population rate of inhalant between 2 and 4 times the rate of the general population (Wu et al., 2004; Sakai et al, 2004)
- Polyinhalant use the norm among this population
 - Among this population, once inhalant use initiated, multiple inhalants is highly likely

Characteristics of Inhalant Use Cont.

- Respondents predominately used 12 inhalants
- Prevention and screening should focus on the commonly abused products
- Policy initiatives could limit youth's accessibility to these products or reformulate them
- Findings imply that youth deliberately chose the most intoxicating inhalants

Modes of Inhalant Use

- Modes of inhalant use were significantly varied
- No existing research on this subject
- Suggestion for future research:
 - Potential negative effects of inhalant use specific to different modalities of use and more specific evaluations of drug administration process

Characteristics of Inhalant Use

- 2/3 of inhalant using youth used them at home or at a friend's home
 - Widespread parent training in the signs of inhalant use is needed
- Many youth use inhalants despite perceiving a moderate or greater level of risk
 - Prevention and treatment strategies should include more than education of dangers
- Incarcerated teen inhalant users return to environments where they are at continued risk for future use
 - Prevention interventions should also target the larger family and peer networks of users

Gender and Lifetime Inhalant Use

- Girls used nail polish significantly more than boys, likely due to increased access
 - Raises important concern about dangers of inhalants to pregnant adolescent girls
 - Additional research needed on gender differences and consequences of inhalant use

Race and Lifetime Inhalant Use

- High rates of inhalant use found among Latino/Latina, Caucasian and Bi/Multiracial youth
- Consistent with previous research, low rates of use found among African American youth (Wu et al., 2004; Nuemark et al., 1998)
- Previous research found that community-level factors did not explain racial differences (Nuemark et al., 1998)
- Unclear why rates of use are low among African American youth

Health and Lifetime Inhalant Use

- Additional research needed to examine high odds ratios observed for kidney and endocrine disorders in inhalant users
- Head injuries with loss of consciousness were common among users
 - High risk for neurological impairments

Mental Health and Lifetime Inhalant Use

- Findings consistent with past research
- Inhalant use has been associated with antisocial behavior, delinquency, and mental health problems in adolescents (Howard and Jenson, 1999; Howard et al., 1999)
- Participants reporting hearing voices when using
 - Research shows auditory hallucinations are common among youth (Dhossche et al., 2002)

Implications and Suggestions for Future Research

- Inhalant users need comprehensive psychosocial and psychiatric interventions
- Additional research needed on:
 - Cognitive, pharmacologic, or social interventions
 - Natural history of inhalant use
 - Factors that contribute to escalation and termination of use

Conclusions

- Current findings consistent with existing research on antisocial youth
- Inhalant use
 - High among within juvenile justice system
 - Associated with psychiatric and health-related comorbidities
 - High among youth with distress related to impaired cognitive function and history of suicidality, trauma, and substance abuse

Study Strengths and Limitations

- Strengths
 - High participation rate
 - Large sample size
 - Detailed inhalant use assessment
- Limitations
 - Reliance on self-report measures
 - Not generalizable to broader population

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