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Zila M. Sanchez PhD [a], Luciana A. Ribeiro MSc [b], Yone G. Moura MSc [b], Ana R. Noto PhD [b] & Silvia S. Martins MD, PhD [c]

[a] Department of Preventive Medicine, Universidade Federal de São Paulo, São Paulo, Brazil
[b] Department of Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil
[c] Department of Epidemiology, Columbia University, New York, USA

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INHALANTS AS INTERMEDIATE DRUGS BETWEEN LEGAL AND ILLEGAL DRUGS AMONG MIDDLE AND HIGH SCHOOL STUDENTS

Zila M. Sanchez, PhD[1], Luciana A. Ribeiro, MSc[2], Yone G. Moura, MSc[2], Ana R. Noto, PhD[2], Silvia S. Martins, MD, PhD[3]

[1]Department of Preventive Medicine, Universidade Federal de São Paulo, São Paulo, Brazil
[2]Department of Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil
[3]Department of Epidemiology, Columbia University, New York, USA

The aims of this study are to: (1) describe the prevalence and sociodemographic characteristics of inhalant use among middle and high school students in Brazil, and (2) test the hypothesis of inhalants being intermediate drugs between legal and illegal drug use. A representative sample of 5226 students from private schools in São Paulo, Brazil, was selected to answer a self-report questionnaire. Weighted data was analyzed through Cox proportional hazards models. In the overall sample, inhalants seems to be an intermediate drug, since prior inhalant initiation was associated with first marijuana use, adjusted for previous alcohol and tobacco initiation.

KEYWORDS. Inhalants, student, epidemiology, adolescents, marijuana

INTRODUCTION

The recreational consumption of inhalants is a global problem with significant social and neuropsychiatric consequences to users.[1,2] This group of drugs, which includes glue, gasoline, nail polish, paints, and other organic solvents, can cause a range of neuropsychological impairments, such as parkinsonism, cerebellar ataxia, and encephalopathy.[3] Inhalant use has become more prevalent throughout the world and is increasing, especially among women in developed and developing countries, but the prevalence is still higher among boys.[4]

In Brazil, inhalants are the third most used drug among elementary, middle, and high school students (age range, 10 to 18 years) after alcohol and tobacco and has a lifetime prevalence of 15%, a past-year prevalence of 14%, and a past-month prevalence of 10%, with emphasis on use among boys.[5] This prevalence is similar to that among 8th and 10th grade students in the United States but is higher than that found among 12th grade students in the United States[6] and much higher than that found among all other South American students. For instance, among 15- and 16-year-old students in Paraguai, Peru, Chile, and Argentina, the lifetime prevalence of inhalants varies from 2.6% to 6.1%.[7] The same pattern of a lower lifetime use is found in Europe, where only Irish students have lifetime prevalence as high as Brazilian students.[8]

In addition to the high prevalence of use, the low risk perception that teens have about the recreational use of inhalants[9] and its role as a marker of vulnerability for involvement with illegal drugs[10] stands out as a health concern. Illustrating the relevance of inhalants use within the substance use disorders scenario, a representative study of U.S. adults showed that almost all lifetime inhalant users met criteria for a substance use disorder, with a 96% prevalence rate of any substance use disorder among

Address correspondence to Zila M. Sanchez, PhD, Department of Preventive Medicine, Universidade Federal de São Paulo, Rua Bprges Lagoa, 1341, São Paulo 04022-000, Brazil. E-mail: zila.sanchez@unifesp.br

those who reported lifetime use of inhalants.[11] Among adolescents who tried marijuana and inhalants, there is a higher prevalence of alcohol and other drug-related disorders (35% and 39%, respectively).[12]

In addition, lifetime use of inhalants appears to precede first use of several illegal drugs, such as heroin and other opiates, cocaine, and hallucinogens.[13] Data from a longitudinal study among 600 adults showed that those with a history of inhalant use during adolescence were nine times more likely to subsequently initiate heroin use.[14] Corroborating this fact, Storr et al.[10] analyzed data from American first-grade students who were longitudinally studied through young adulthood and reported that those who used inhalants before age 14 years were twice as likely to initiate the use of opioids than those who never used inhalants.[10]

Therefore, the association between the future use of some illegal drugs and prior use of inhalants may follows the logic of the "developmental stages of drug involvement theory" among adolescents,[15,16] although inhalants are not explicitly described in this drug use trajectory. According to this theory, which was initially described as a progression of drug use from legal to illegal drugs, marijuana use would be considered the first step for the illegal drugs, which occurs after the consumption of alcohol and tobacco.[17] This phenomenon occurs through the following stages: (1) no drug use, (2) use of alcohol and tobacco, (3) marijuana use, and (4) use of other hard drugs. It is important to note that the position on a particular point in the sequence does not indicate that the adolescent will necessarily end up using other drugs higher up in the sequence. Rather, Kandel[15] suggested that the use of a drug lower in a sequence is a necessary but not sufficient condition for progression to a higher stage indicating involvement with more serious drugs. Although this theory can be important for prevention programs, it is unclear where inhalants are included in this process and targeting the reduction of future use of other drugs by adolescents who are exposed to drugs in the first steps is important.[18] Considering this theory and that most inhalants are legally sold in Brazil, we hypothesized that inhalants must be used prior to the first marijuana use. However, because some inhalants may be illegal drugs, the developmental stages of drug involvement theory may not apply to these drugs.

Despite recreational inhalant use being a highly prevalent behavior among adolescents in several countries, the characteristics of inhalant consumption are understudied. The aims of this study are to describe the prevalence and sociodemographic characteristics of inhalant use among middle and high school students in São Paulo, Brazil, and to assess the hazards associated with prior inhalant use on future marijuana use within the sample, testing the hypothesis of inhalants being intermediate drugs between the use of legal (e.g., alcohol, tobacco) and illegal drug use (e.g., marijuana). If this hypothesis holds true, the age of first inhalant use would precede the age of first marijuana use. Gender differences for this hypothesis are also tested.

METHODS

Sample

Data came from a representative sample of students at private schools in Sao Paulo, Brazil, from 8th to 12th grades (middle school = 8th-9th grade; high school = 10th-12th grade).[19] A two-step randomization process was used; the schools were stratified according to the average income of the neighborhood in which they were located (the ratio of schools in low- and high-income neighborhoods was 2:3) and then the sample was selected by clusters (classrooms). All of the students in each selected class were invited to complete the questionnaires. The sample size was set for a maximum 10% relative error and a 95% confidence interval (CI). São Paulo has 823 private schools, and 37 were included in this study. The response rate among the students invited to participate was 99.6%. The process generated a final sample of 5226 students. The complex survey design took into account the stratum (neighborhoods in which schools were located), the cluster (the school was the primary sampling unit), the

expansion weight, and the probability of drawing the student who answered the questionnaire.[19]

Data Collection

Data collection was conducted in the classroom without a teacher present over 35 minutes. A trained team explained the objectives of the study and distributed a self-reported questionnaire with closed questions based on a World Health Organization instrument[20] and the European School Survey Project on Alcohol and Other Drugs questionnaire,[8] adapted to the Brazilian culture.

Measures

The instruments included questions about age of onset of alcohol, tobacco, inhalants, and marijuana use; lifetime use of inhalants; past year use (12 months prior to the research); and past month use (30 days prior to the research). Lifetime use and past year use were categorized as an yes/no question. Past month use was categorized in 1–5 days (low use), 6–19 days (frequent use), and 20 days or more (heavy use).[20] The question for age of onset was an open question (at what age you first tried "X"). For inhalant use, the questionnaire included questions that asked about which inhalant was used in the 30 days prior to the survey and the possible answers were: *loló* or *lança*, gasoline, nail polish and nail polish remover (acetone), paint and paint products (such as paint removers and paint thinners), ether, and glue. *Lança* (also known as *lança-perfume*) and *loló* are ether and chloroform products usually clandestinely made in the chemistry laboratories of colleges by college students and used by youth in parties. These products also have cereal ethanol and a sugary candy besides ether or chloroform in their formula and are inhaled. *Lança* is sometimes trafficked from Argentina to Brazil. Although acetone, nail polish, and paint products can be freely sold in the Brazilian market, the mixture of chloroform and ether (*lança* and *loló*) is illegal in Brazil. Thus, inhalants can be fitted among both legal and illegal drugs. One question on the use of a fictitious drug was used to exclude 7(0.1%) students who gave a positive answer to it.

The socioeconomic status was measured by the Associação Brasileira de Empresas de Pesquisa (ABEP) index. The ABEP index is based on the highest level of education obtained by the head of the household, the possession of various types of household goods (e.g., television sets), and number of housekeepers.[21] This index was used to sort participants into standardized social class subgroups labeled from A to E (where A1 was the highest economic strata).

Data Analysis

Demographic characteristics such as grade at school and gender of the selected sample were analyzed through cross-tabulations and chi-square tests, with a level of significance of 5%. Then, to investigate a potential pathway between inhalant initiation and marijuana initiation using retrospective reports of age of onset, we used survival analyses methods such as Kaplan-Meier survival curves and Nelson-Aalen cumulative hazard curves followed by Cox proportional hazards models with time-dependent covariates.[22] Hazards ratios from Cox proportional hazards models provide estimates of the relative risk of an outcome over time for those with a specified risk factor versus those without the factor.[23] By using time-dependent covariates, it is possible to take into account the change in the respondent's independent variable status (e.g., using alcohol as a time-dependent covariate, a respondent will be a non-alcohol user until the year he or she first used alcohol and then be counted as an alcohol user from thereafter). These survival analysis regression models also provide for statistical adjustments (e.g., for suspected confounding variables such as sex). Chronological age was used as the indicator of time, and data from respondents not experiencing the specified outcome by the time of the final interview were censored.

In cases in which the outcome and time-dependent covariate occurred during the same year (e.g., ties), it was impossible to determine which came first. To avoid imposing a temporal sequence based on a priori assumptions, observations with tied onset times were censored just before the year in which the tie occurred. Different sets of Cox proportional

hazards models with time-dependent covariates (e.g., alcohol and tobacco were added to the inhalant models as time-dependent covariates) were used to estimate the relative hazards of initiating marijuana use after first initiating tobacco, alcohol, and inhalant use because marijuana is usually the first illegal drug individuals use. All analyses were repeated after stratifying by gender. Analyses were performed using Stata Version 11 (Stata Corporation), with the *stcox* command used to address variance estimation under the complex sample design in these regression models and in estimation of all 95% confidence intervals (CI).

Ethical Aspects

Students were informed about anonymity and of the voluntary nature of the research and the freedom they had to opt out at any time or to leave questions unanswered. This study was approved by UNIFESP's Research Ethics Committee.

RESULTS

Descriptive

The response rate among the students invited to participate was 99.6% (Figure 1). Among the 5226 students interviewed, 2691 were in high school and 2535 in middle school. Weighted data analysis showed proportion among genders. The mean age of the adolescents was 14.9 years (SD = 1.5 years). Almost all participants had high socioeconomic status (95% at A and B stratum) (Table 1).

Inhalants were the third most commonly used drugs (13.6% of the overall sample ever tried inhalants) versus 80.3% of alcohol lifetime use, 24.6% tobacco lifetime user, and 10.7% of marijuana lifetime user (Table 1). Table 1 shows that the mean age of first use of each drug was 12.6 years for alcohol, 13.5 years for tobacco, 13.9 years for inhalants, and 14.6 years for marijuana.

Life tables showed that 42% of lifetime users of alcohol have first tried before age 12 years. For tobacco, the first use had occurred prior to age 13 years for 45% of the sample. Inhalants were tried before age 14 years by 50% of the lifetime users and marijuana was tried before age 15 years by 50% of the sample (data not show in table).

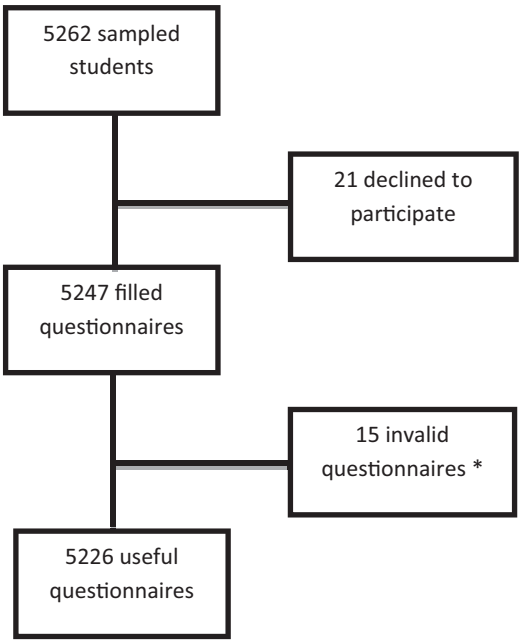

FIGURE 1. Flowchart of participants of the survey. Data from São Paulo City private school survey, Brazil, 2008. *positive for fictious drug or missing in more than 30% of the questions

Table 2 characterizes inhalant use among middle and high school students. Almost 14.0% (95% CI = 12.2; 15.2%) of the overall sample, 16.2% (95% CI = 14.4; 18.2%) of the boys and 11% (95% CI = 9.0; 13.3%) of the girls were lifetime inhalant users. Comparing students from middle and high school, there were differences in patterns of lifetime use between groups of different educational levels ($P = .05$), but no differences in the prevalence of recent inhalant use ($P = .4$). There were also differences for the type of inhalant used when comparing educational level: high school students use more *lança* and *loló* and middle school students used more nail polish and acetone. Among high school respondents who had used inhalants in the month preceding the survey, 71.9% [95% CI = 56.4; 83.5%] reported using *lança* and *lolo* and middle school students reported they used more nail polish and acetone (41.7% [95% CI = 30.4; 53.9%]) and gasoline (38.4% [95% CI = 24.5; 54.4%]).

TABLE 1. Description of the Study Sample: Unweighted Data, Weighted Prevalence Proportions, and 95% CI[a]

Sociodemographic characteristics	No	%	95%CI	
Gender				
Male	2513	50.3	47.8	52.8
Female	2623	49.7	47.2	52.2
Age, y				
10–12	116	2.0	1.4	2.7
13–15	3181	60.9	55.0	66.4
16–18	1821	36.7	31.1	42.6
> 18	14	0.3	0.1	0.8
Grade				
8th	1297	23.3	18.6	28.8
9th	1238	22.3	18.7	26.4
10th	963	20.8	16.6	25.7
11th	971	18.3	14.7	22.4
12th	757	15.3	11.7	19.7
Socioeconomic status				
A1	464	10.3	6.6	15.8
A2	1492	34.4	30.1	39.0
B1	1439	31.8	28.6	35.2
B2	833	18.3	14.5	22.8
C/D/E	248	5.0	3.7	6.9
Lifetime drug use				
Alcohol	4185	80.3	77.6	82.8
Tobacco	1278	24.6	22.1	27.4
Inhalants	719	13.6	12.2	15.2
Marijuana	532	10.7	8.2	15.7
Past year drug use				
Alcohol	3288	63.1	59.2	66.8
Tobacco	878	17.1	15.0	19.5
Inhalants	430	8.6	7.3	10.0
Marijuana	396	7.9	5.7	10.9
Past month drug use				
Alcohol	2059	39.6	35.9	43.5
Tobacco	528	10.2	8.6	12.0
Inhalants	185	3.7	3.1	4.5
Marijuana	203	3.8	2.5	5.7

[a]Data from São Paulo City private school survey, Brazil, 2008 (n = 5526).

High school students seem to use more illegal inhalants (e.g., *lança* and *loló*) and less legal (e.g., nail polish, glue, acetone) inhalants, whereas middle school students preferred to use legal inhalants.

It is worth noting that there were gender differences in the pattern of lifetime use and past year use; lifetime inhalant use was more prevalent among boys than among girls (16.2% vs. 11%, $P = <.001$). Past year use is also more prevalent among boys than among girls (10.6% vs. 6.6%, $P = .001$); however, there were no gender differences in recent use (past month) prevalence. Also, there were no gender differences in type of inhalant consumed.

Hazard of Marijuana Initiation After Inhalants, Alcohol, and Tobacco Initiation

Among those who used inhalants, 56.9% (95% CI = 49.1; 64.4%; n = 284) also used marijuana and of them 93.7% (95% CI = 89.9; 96.1%; n = 266) initiated marijuana use after first initiating inhalant use. Alcohol and tobacco seem to be the first drugs used by these adolescents: 92.9% (95% CI = 86.5; 96.5%) of them used alcohol before first using inhalants and 81.5% (95% Cl = 69.7; 89.4%) used tobacco prior to first inhalant use (data not shown in table). Previous alcohol, tobacco, and inhalant initiation were significantly associated with an increased likelihood of subsequent marijuana initiation, adjusted for age and sex (Table 3).

Initiating first inhalant use before first marijuana use increases the risk of using marijuana in both unadjusted and adjusted Cox models. When adjusted for alcohol, tobacco, sex, and age, this association diminishes considerably (unadjusted hazard ratio [HR] = 4.3 [3.1–6.1], adjusted HR = 1.7 [1.1–2.5]). Initiating first use of alcohol or tobacco before first marijuana use also increases the risk of using marijuana in both unadjusted and adjusted Cox models. Prior alcohol use is associated with an increased risk of subsequent marijuana use (unadjusted HR = 4.3 [3.3–5.7], adjusted HR = 2.8 [2.1–3.8]). The association is even stronger for tobacco use prior to marijuana use (unadjusted HR = 8.7 [6.6–11.4], adjusted HR = 6.0 [4.4–8.3]).

When stratified by gender, the pathway of initiating marijuana after the first inhalant use was significant for girls in the unadjusted model (HR = 4.3 [3.2–7.0]) and in the model adjusted for previous alcohol and tobacco initiation (HR = 1.9 [1.1–3.5]). Among boys, although the unadjusted model showed that the pathway of initiating marijuana after the first inhalant use was significant (HR = 4.1 [2.6–6.4]), there was only a trend of significance (HR = 1.5 [0.9–2.7]) when adjusted for previous alcohol and tobacco initiation. Initiating first use of

TABLE 2. Distribution of Inhalant Use Among 5226 Private School Students and Bivariate Analysis by Gender and Grade

	Boys			Girls				Junior high			High school				Total		
Inhalants	No.	%	95% CI	No.	%	95% CI	P^b	No.	%	95% CI	No.	%	95% CI	P^c	No.	%	95% CI
Lifetime use	404	16.2	(14.4, 18.2)	302	11.0	(9.0, 13.3)	<.01	297	11.5	(9.3, 14.1)	422	15.4	(13.1, 18.0)	.05	719	13.7	(12.2, 15.2)
Past year use	255	10.6	(8.9, 12.5)	169	6.6	(5.1, 8.4)	<.001	176	7.1	(5.3, 9.4)	254	9.8	(7.9, 12.1)	.09	430	8.6	(7.3, 10)
Past month use	114	4.3	(3.5, 5.4)	70	3.0	(2.1, 4.4)	.10	84	3.4	(2.5, 4.4)	101	3.9	(3.0, 5.1)	.42	185	3.7	(3.1, 4.5)
Inhalant used[a]																	
Loló/lança	64	55.9	(41.5, 69.3)	44	56.2	(30.1, 79.3)	.90	36	34.4	(18.3, 55.1)	73	71.9	(56.4, 83.5)	<.001	109	56.2	(38.4, 72.6)
Nail polish/acetone	35	31.8	(19.9, 46.6)	20	31.3	(18.2, 48.2)	.93	30	41.7	(30.4, 53.9)	26	24.8	(13.6, 40.9)	.02	56	32	(20.6, 45.9)
Gasoline	30	28.1	(18.1, 40.8)	16	24.4	(13.6, 39.8)	.52	29	38.4	(24.5, 54.4)	17	17.8	(10.8, 28.0)	<.01	46	26.5	(17.2, 38.5)
Glue	20	15.4	(8.8, 25.6)	9	15.8	(7.2, 31.2)	.94	17	22.2	(9.8, 42.8)	12	10.6	(5.0, 21.3)	.19	29	15.5	(8.7, 26.1)
Painting product	18	15.5	(6.9, 31.2)	6	13.5	(5.0, 31.8)	.63	15	21.7	(9.2, 43.0)	9	9.5	(4.6, 18.7)	<.01	24	14.7	(6.5, 29.9)
Ether	4	3.1	(0.9, 10.3)	1	1.1	(0.1, 8.5)	.40	2	1.9	(0.4, 8.1)	4	3.4	(1.0, 10.8)	.48	6	2.8	(1, 7.8)

[a]Only among past month users.
[b]Chi square test p value for gender comparison.
[c]Chi square test p value for grade comparison.

TABLE 3. The Relative Hazards of Initiating Marijuana Use After First Initiating Tobacco, Alcohol, and Inhalant Use[a]

Initiating marijuana	uHR	95%CI	*P*	aHR[b]	95%CI	*P*
Girls and boys						
After first alcohol use	4.3	3.3–5.7	<.001	2.8	2.1–3.8	<.001
After first tobacco use	8.7	6.6–11.4	<.001	6.0	4.4–8.3	<.001
After first inhalant use	4.3	3.1–6.1	<.001	1.7	1.1–2.5	.01
Girls only						
After first alcohol use	4.8	3.2–7.0	<.001	3.2	2.0–5.2	<.001
After first tobacco use	7.7	5.2–11.4	<.001	5.2	3.3–8.2	<.001
After first inhalant use	4.3	2.4–7.5	<.001	1.9	1.1–3.5	.02
Boys only						
After first alcohol use	4.0	2.7–5.8	<.001	2.4	1.6–3.7	<.001
After first tobacco use	9.8	6.9–13.9	<.001	6.7	4.4–10.3	<.001
After first inhalant use	4.1	2.6–6.4	<.001	1.5	0.9–2.7	.1

[a]n = 4996 private school students in São Paulo, Brazil.
[b]model considering simultaneously tobacco, alcohol and inhalants, adjusted for age, the first three models were also adjusted for sex.

alcohol or tobacco was significantly associated with increased risk of subsequent marijuana use in both unadjusted and adjusted Cox models for boys and for girls.

DISCUSSION

This study indicates that lifetime and past year use of inhalants is more common among boys, although there are no gender differences in the pattern of recent use. High school students prefer to use illegal inhalants, such as *lolo* and *lança*, whereas the middle school students prefer legal inhalants such as nail polish, acetone, and gasoline. Overall, in some cases inhalants seems to be an intermediate between legal (alcohol and tobacco) and illegal (marijuana) drugs because the majority of the sample that used both drugs has used inhalants first and prior inhalant initiation was significantly associated with future marijuana use, even when adjusted for previous alcohol and tobacco initiation.

Before a detailed discussion of these findings can be had, a few limitations should be mentioned. Nonparticipation and missing data excluded 94 students from the analysis. However, the levels of participation were larger than those obtained in the widely cited annual U.S. Monitoring the Future surveys.[6] In addition, due to the fact that a self-report questionnaire was used, the questions were subject to interpretation by the participants. However, the anonymous nature of the survey and the absence of the teacher in the classroom should help promote response validity. Also, using age of onset of each substance resulted in some ambiguity regarding the exact sequence of substances used due to ties. For example, an individual who initiated use of both inhalant and marijuana at the same age may have progressed from inhalant to marijuana or vice versa. Studies accessing the month, day, and year of onset would have more validity. It would also be important to included questions on psychiatric comorbidity, bullying, and social behavior in a future survey, and the lack of these questions is a limitation of this study. Despite limitations, this study has several strengths; it had a high level of participation of students and schools, and it is the first study to investigate patterns of inhalant use among relatively wealthy middle and high school students in one of the largest cities in the world and the largest in Latin America (together with Mexico City).[24]

The use of inhalants has an important role in the drug use epidemiology around the world,[4] and Brazil is one of the countries in which this consumption has been identified as the most prominent on the international scene.[5] Data from this study show a higher lifetime prevalence of inhalants use by high school students than the prevalence found in cross-sectional surveys among middle and high school students conducted in the North and South America and Europe.[6–8] Although inhalant use has been clearly associated with low-income

situations in this study's sample (e.g, the high consumption of glue among street children[25]), the use of nail polish/acetone, gasoline, and *loló* and *lança* that's characterized by students from a high socioeconomic status stands out. Our findings suggest that the first access to these substances occurs at home, whereas younger adolescents reported mainly the consumption of household products. In contrast, older adolescents consumed few household items and reported higher consumption of illegal inhalants, which can be obtained through drug trafficking, as has been recently described by the media.[26] These findings suggest a progression from legal to illegal inhalants; students may start with using lawful household products and migrate to the unlawful *loló* and *lança*, which is obtained from drug dealers and friends. However, it is possible that the difference between nail polish and *lança* use has more to do with access at home than with lawfulness of sales.

Although many studies have characterized marijuana as a first step to the use of other illegal drugs,[27] the current study suggests that in some cases inhalants could be vulnerability markers for marijuana use. Thus, a new step on the drug use progression after the use of alcohol and tobacco, as defined by the lifetime use of inhalants, could be included in the proposed developmental stages theory of Kandel.[15]

When analyzing the crude odds of the Cox model for boys and girls, we noted that the prior initiation of inhalants substantially increases the risk of marijuana use initiation. However, when we controlled the model for previous initiation of alcohol and tobacco, the magnitude of the hazards ratios diminished for both genders and becomes nonsignificant for boys (the group with the highest prevalence of lifetime inhalant use). It is already established that alcohol and tobacco are drugs that adolescents usually initiate before marijuana first use;[27,28] however, inhalants can be considered markers of vulnerability for marijuana initiation because prior inhalant initiation increases the chances of marijuana initiation, even when controlled for prior initiation of alcohol and tobacco. Thus, identifying the early use of inhalants among adolescents would allow an early intervention for future marijuana initiation. Some authors, considering the magnitude of the relevance of inhalants use, suggest that questions about inhalation and solvent abuse should be part of any screening and intervention on substance abuse.[29]

Nevertheless, it is important to note that the existence of a drug use pathway between inhalant and marijuana use does not necessarily imply causal linkages among these drugs because the observed sequences could simply reflect the association of each class of drugs with different attributes of the adolescent rather than the specific effect of the use of one class of drug on the use of another.[27] For example, this drug use sequence could simply reflect the existence of unmeasured common causes, such as a risk-taking predisposition and latent propensity to use drugs as just one of a range of risk behaviors.[30]

Although this study uses similar samples of school-based children as the developmental stages of drug involvement theory[15] does and suggests that previous use of inhalant may predict future use of marijuana, the associations found may be due the fact that these individuals have environmental and social influences that increase their likelihood of substance use—independent of the substance used previously or later in their lives and of the lawful condition of each drug. However, our instrument did not allowed us to access proximal measures (e.g., reasons for use, peer use, or why was first used), and it would be valuable to have this type of data analyses in a future study to test for the strongest influence for drug use progression.

Despite the role of inhalants as independent markers of vulnerability for the initiation of other drugs use, the use of inhalants by itself should be considered a risk behavior. Because the acute pharmacological and behavioral effects of many inhalants are similar to those observed in acute alcohol intoxication and other drugs that act as depressants to the central nervous system,[31] risks of depressant intoxication may also be identified in the acute consumption of inhalants. In addition, it is important to highlight the potentially fatal cardiac effects of inhalant consumption, even on a single occasion. Thus, death, which is the greater immediate

risk related to use of inhalants, has been widely reported in the scientific literature.[29] Generalizability of the findings may be limited because the sample of wealthy middle and high school students in São Paulo is specific and cannot be fully extrapolated to other socioeconomic strata and other cultures.

CONCLUSIONS

This study shows that early use of inhalants as recreational drugs starts with household products and migrates to illegal inhalants (such as *lança* and *loló*) as adolescents age. In this sample, inhalants appear to act as intermediates between legal (alcohol and tobacco) and illegal (marijuana) drugs, suggesting, at least for our population of girls, a new step in the developmental stages of drug involvement theory. Thus, besides all of the well-known organic impairment associated with the use of inhalants, such as cardiac, renal, and neurological diseases, this class of drugs seems to have a role as a vulnerability marker for the future marijuana use. Therefore, identifying the use of inhalants among adolescents would allow an early intervention for future initiation of marijuana use. Moreover, there is still a need for qualitative studies that allow the interpretation of the role of prior consumption of inhalants in the decision to initiate marijuana use by adolescents and the progression of consumption from legal to illegal inhalants.

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