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ORIGINAL ARTICLE

Predictors of School Violence Perpetration and Victimization: Effects of Drug Use and Sociodemographic Characteristics

Julia D. Gusmoes[1] · Juliana Y. Valente[1] · Hugo Cogo-Moreira[2] · Zila M. Sanchez[1]

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Abstract
A randomized controlled trial was conducted with 6391 7th- and 8th-grade students in 72 public schools in six Brazilian cities. A confirmatory factor analysis was performed to create a unidimensional model for validity. Linear regression was used to evaluate how baseline past-month drug use, violence, and sociodemographic characteristics affected violence at follow-up. The results showed that previous involvement in violent episodes at school ($\beta = 0.397$, $p < 0.001$) as well as the use of inhalants at baseline ($\beta = 0.358$, $p = 0.026$) predicted higher levels of violence 9 months after baseline. Additionally, girls showed lower levels of involvement in violence than boys ($\beta = -0.144$, $p < 0.001$). School prevention programs and policies should simultaneously address drug use and violence. Inhalant use seems to act as a proxy of future involvement in school violence, independent of previous involvement in violent episodes. Trial registration: RebEC, RBR-4mnv5g. Registered 3 July 2014, http://www.ensaiosclinicos.gov.br/rg/RBR-4mnv5g/.

Keywords School violence · Substance use · Prevention · Adolescence · Confirmatory factor analysis

Violent events at school are becoming increasingly common (Devries et al. 2014) and a major public health concern (Shetgiri et al. 2011). According to a school-based survey with Brazilian

✉ Zila M. Sanchez
zila.sanchez@unifesp.br

Julia D. Gusmoes
dellsol.julia@gmail.com

Juliana Y. Valente
jyvalente@gmail.com

Hugo Cogo-Moreira
hugocogobr@gmail.com

Extended author information available on the last page of the article

adolescents, 12.9% of over 60,000 students surveyed reported being involved in physical aggression episodes in the past 30 days (Malta et al. 2010), and 12.9% reported being a victim of bullying; even more alarming, 20.8% reported perpetrating this violence (Malta et al. 2014).

School violence is a phenomenon that can encompasses verbal, physical, and sexual violence in addition to bullying (UNESCO 2017). Bullying is differentiated from other forms of violence based on the repetition of bullying acts over time and the asymmetry that exists between the bully and the victim (Olweus 1996). Physical, verbal, and sexual violence are defined as isolated episodes of physical harm (Nations and Representative 2011), verbal assault (Attar-Schwartz and Khoury-Kassabri 2008), or sexual harassment (Espelage et al. 2012). Studies differentiate whether students are victims (Finkelhor et al. 2014) or perpetrators (Espelage et al. 2012) of violence.

All types of school violence affect adolescent development and wellbeing (Arseneault 2018; Moore et al. 2017), threaten the integrity of adolescents, and jeopardize the quality of their education (Eyng et al. 2009). These violent acts can also impact their mental and emotional wellbeing (Healey et al. 2014) and are associated with poor academic outcomes and school dropouts (Fernández-Suárez et al. 2016). Violence victimization is associated with more victimization later in life and consequent depression (Ttofi et al. 2011), and violence perpetration is associated with delinquent behaviors and even suicide (Farrington et al. 2011).

The scientific literature indicates that violent adolescent behavior frequently co-occurs with substance use (Healey et al. 2014; Herrenkohl et al. 2012; Shetgiri et al. 2011) among both perpetrators and victims (Herrenkohl et al. 2012). There are several mechanisms through which violence and substance use may co-occur in adolescence, as it is a period of a higher imbalance between increased impulsivity and reward sensitivity and reduced inhibitory control (Steinberg 2004), and it is also a period of life in which emotional changes create vulnerability; thus, adolescents are less able to address emotions and distress than people of other ages (Fisher et al. 2012).

However, most studies have only examined the association between drug use and violence (Gilreath et al. 2014), while only a few have shown causal effects of the former on the latter (Herrenkohl et al. 2012). Additionally, most studies have been limited to conceptualizing the types of school violence separately without considering the simultaneity of more than one type of violence (Farrington et al. 2011; Gilreath et al. 2014; Malta et al. 2010; Shetgiri et al. 2011). The existing literature suggests that the repetition and severity of violence as well as the type of victimization (i.e., physical or verbal/relational) are significantly associated with health outcomes (Gregory et al. 2010).

Epidemiological examinations of how types of violence intersect with drug use could contribute greatly to understanding the empirical and conceptual linkages between these behaviors (Gilreath et al. 2014). Thus, to fill the gap in the literature regarding the impact of drug use on episodes of violence among adolescents in low- and middle-income countries, the present study aimed to examine whether drug use predicts school violence perpetration and victimization.

Material and Methods

This study presents the results from analyses of baseline and 9-month follow-up data collected in a randomized, parallel-group controlled trial to evaluate a school drug use prevention program. Participants included 7th- and 8th-grade public school students in six Brazilian cities

(São Paulo, São Bernardo do Campo, Distrito Federal, Florianópolis, Tubarão, and Fortaleza). In partnership with the Brazilian branch of the United Nations Office on Drugs and Crime (UNODC), the Brazilian Ministry of Health decided to implement a culturally adapted version of the European drug prevention program Unplugged, renamed as #Tamojunto, and was applied in Brazilian public schools (Sanchez et al. 2017).

This study examined the data of this sample from baseline (prior to the intervention) to a 9-month follow-up (Sanchez et al. 2017). The two-arm randomized controlled trial (RCT) originally compared the integration of the prevention program #Tamojunto into the school curricula (intervention condition) with the usual curricula in Brazil, that is, without any prevention program (control condition). The RCT was registered at the Brazilian Clinical Trials Registry (REBEC) under protocol number RBR-4mnv5g, and the study protocol was approved by the Research Ethics Committee of Universidade Federal de São Paulo (protocol #473,498).

Sampling

The sample consisted of 6391 students (Fig. 1) aged 11–15 in 7th and 8th grades at 72 public schools in six Brazilian cities. The cities were chosen by the Brazilian Ministry of Health, while the schools were randomly selected in proportion to the number of schools in each city (stratum). A second allocation determined whether the school would be assigned to the control or intervention group according to a random list, which also maintained a 1:1 allocation ratio per municipality.

Based on Lwanga and Lemeshow's (1991) calculation of sample sizes for longitudinal studies, the sample size necessary for each group in this study was calculated to be 2835 participants for a power of 80%, a significance level of 5%, and a difference between the groups of 1.5 percentage points (5 to 3.5%). Taking into account a participant loss of 50%, the sample needed to include 4253 participants in each group. The parameters that were used were based on a previous pilot study and the expected results of the RCT. Details of the study design and a flowchart of the sampling were presented in a previous publication (Sanchez et al. 2017).

Instrument

The data were collected through an anonymous questionnaire completed by the participants and applied by researchers in the classroom without the teacher. The survey was developed and tested by the European Drug Addiction Prevention Trial (EU-DAP) program and was used in previous studies on the effectiveness of Unplugged (Faggiano et al. 2008). An adapted Portuguese version was used in Brazil, with some questions replaced by items from two questionnaires that have been widely used in various studies with Brazilian students: a World Health Organization questionnaire used by the Brazilian Center for Information on Psychotropic Drugs (Centro Brasileiro de Informações Sobre Drogas Psicotrópicas - CEBRID) (Carlini et al. 2010) and a questionnaire from the National Survey of Student Health (Pesquisa Nacional de Saúde do Escolar - PeNSE) used by the Brazilian Ministry of Health (Instituto Brasileiro de Geografia e Estatística 2015).

The questionnaire included binary responses ("yes" or "no") concerning the use of the following substances over the previous month: alcohol, tobacco, marijuana, inhalants, and cocaine. In addition, it assessed binge drinking (i.e., the consumption of 5 or more doses of

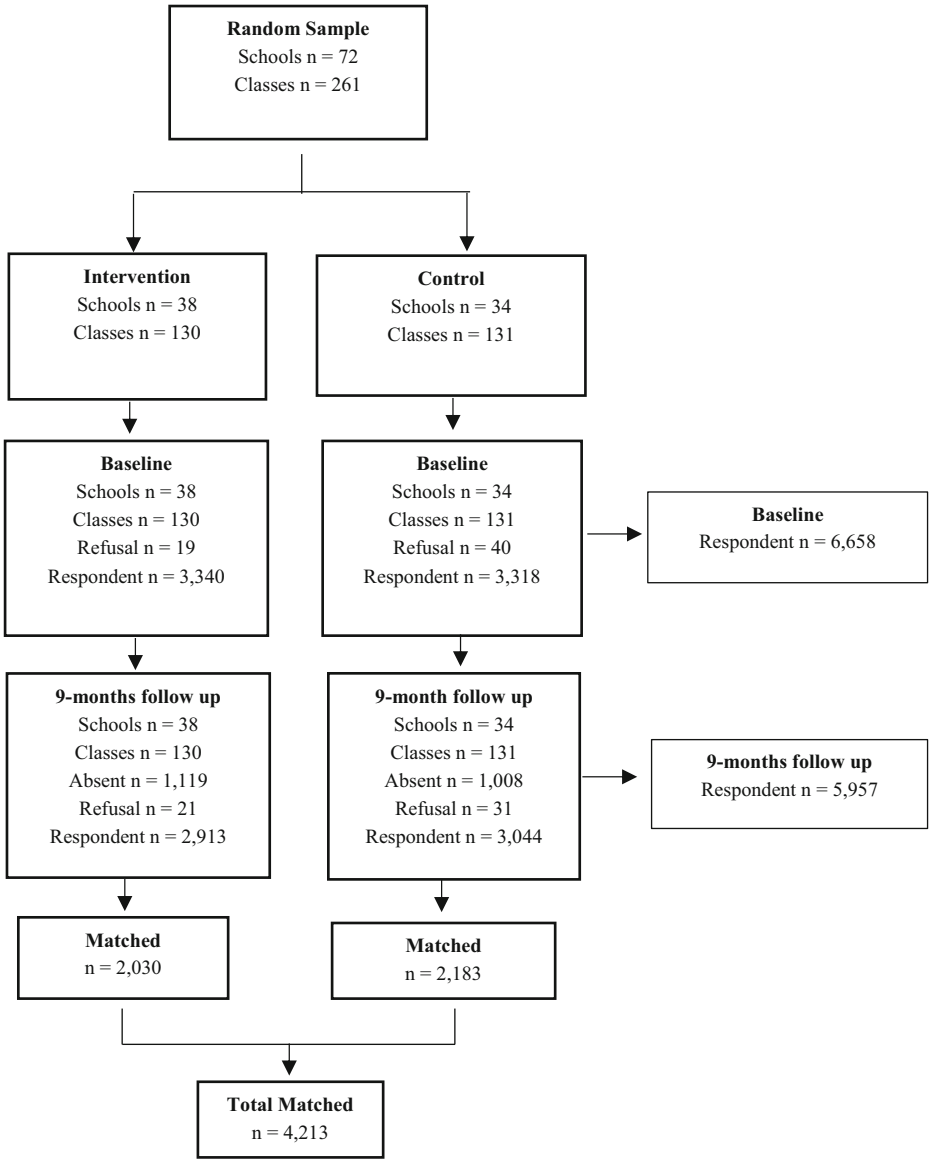

Fig. 1 Flowchart of total sample data and sample from baseline and 9-month follow-up. Brazil, 2014

alcohol during a 2-h period) and sociodemographic data (sex, age, and socioeconomic status [SES]).

The outcomes analyzed were the types of school violence from wave 2 (9 months after baseline), which included the victimization and perpetration of bullying, verbal violence, physical violence, and sexual violence in the past 30 days. The items used to assess verbal, physical, and sexual violence were "In the past 30 days, have you been verbally/physically/sexually assaulted at your school?" and "In the past 30 days, have you verbally/physically/sexually assaulted anyone at your school?" ("yes" or "no"). The following items were used to

analyze the perpetration and victimization of bullying in the questionnaire: "In the past 30 days, how often have your classmates scolded you, bullied you, or teased you so much that you were hurt, harassed, annoyed, offended or humiliated?" and "In the past 30 days, have you scolded, mocked, manipulated, intimidated or teased any of your classmates so much that s/he was hurt, annoyed, offended or humiliated?"

The original response items were "never," "sometimes," and "always," which we transformed to binary responses (yes/no) by grouping the answers "sometimes" and "always" to obtain the "yes" group, and the response "never" was considered "no."

The assessed explanatory variables (predictors) used were three sets of variables from the wave 1 (baseline) data assessment: control variables (age, sex, SES, randomization group); use (yes/no) of alcohol, tobacco, marijuana, and inhalants within the past year; and binge drinking (yes/no) within the past year. Binge drinking was defined as the consumption of 5 or more doses of alcohol during a 2-h period. The occurrence (yes/no) of alcohol use, tobacco use, marijuana use, inhalant use, and binge drinking within the past year was assessed with 5 questions, such as "From one year to the next, i.e., in the last 12 months, have you drunk alcoholic beverages?"

The students' SES was assessed using the scale of the Brazilian Association of Research Companies (Associação Brasileira de Empresas de Pesquisa - ABEP) (ABEP, Associação Brasileiro de Empresas de Pesquisa 2012), which considers the head-of-household's education level as well as the goods and services used. The scores ranged from 0 to 46, with higher scores indicating higher economic status, and were classified into categories ranging from A (highest) to E (lowest).

Statistical Analysis

Because the scale used to assess violence among adolescents had not been previously assessed regarding construct validity, we used confirmatory factor analysis to evaluate this. We tested an a priori hypothesis of a unidimensional solution, in which the 8 items were loaded into a single latent factor (Fig. 2). The following fit indices were considered to evaluate the model fit of the violence scale for the two waves. A comparative fit index (CFI) between 0.95 and 0.97 would indicate an acceptable model, as well as a root mean square error of approximation (RMSEA) between 0.05 and 0.08 (Schermelleh-Engel et al. 2003). Given the categorical nature of the items, we used the mean- and variance-adjusted weighted least squares (WLSMV) estimator implemented in Mplus 7.4 (Muthén and Muthén 2012). In cases of misfit, a minor adjustment was conducted based on both modification indices and a theory of how the items are correlated, with focus on the residual covariance.

Because the CFA returned acceptable fit indices regarding the violence factorial solution, to simplify matters, we used the sum of the 8 items on the violence scale as an outcome in the model described below (scores ranging from 0 to 8). The use of sums (formally called *parceling*) is justifiable based on the aggregation principle and the Law of Large Numbers (Little et al. 2013).

Linear regression was used to assess how past-month drug use at baseline (alcohol, binge drinking, tobacco, inhalants, marijuana, cocaine) and involvement in violent episodes at baseline affected violence perpetration and victimization at the 9-month post-intervention follow-up, with adjustment for sociodemographic covariates (randomization group, sex, age, and SES). For the linear regression model, maximum likelihood estimation with robust standard error (MLR) was used as an estimator. The significance level was 5%. School was

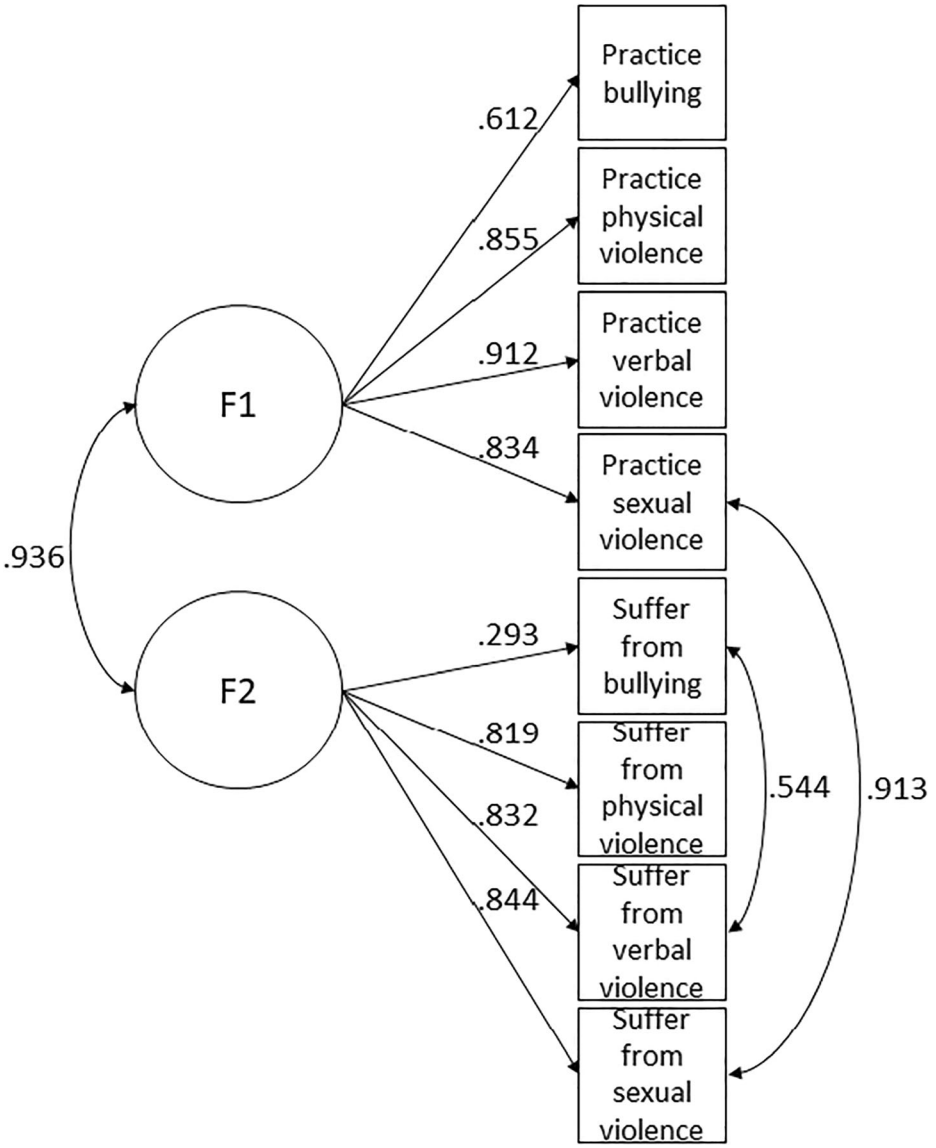

Fig. 2 Magnitude of the correlation between the items and the latent factors F1 and F2

incorporated as a cluster for all the analyses via the ANALYSIS command (TYPE=complex) available in Mplus. Under this command, the standard errors were adjusted according to the nonindependence of the observations (i.e., children nested within schools).

Results

Table 1 presents the demographic characteristics of the students participating in the study ($n = 6391$), which were drawn from the baseline data and data collected

Table 1 Sociodemographic characteristics of students participating in the baseline and 9-month follow-up data collection of a study evaluating the #Tamojunto school-based program of drug use prevention ($N = 6391$)

Variables	*N*	wgt%	wgt95%CI
Baseline measures			
Gender			
Male	3130	48.79	[47.03; 50.56]
Female	3261	51.21	[49.44; 52.97]
Age			
11–12 years	3343	53.83	[50.91; 56.72]
13–15 years	3048	46.17	[43.28; 49.09]
Average age		12.61	[12.56; 12.67]
ABEP score			
		27.67	[26.92; 28.41]
A (35–42)	244	3.78	[2.80; 5.11]
B (23–34)	2467	36.64	[33.54; 39.85]
C (14–22)	3343	53.98	[50.41; 57.50]
D/E (0–13)	322	5.60	[4.60; 6.80]
Use in the past month			
Alcohol	1002	15.74	[14.87; 16.66]
Binge drinking	787	12.44	[11.65; 13.28]
Tobacco	115	1.81	[1.51; 2.17]
Inhalants	176	2.78	[2.39; 3.21]
Marijuana	76	1.20	[0.96; 1.50]
Cocaine	10	0.16	[0.09; 0.29]
Practicing violence			
Bullying	1156	18.43	[17.48; 19.40]
Verbal	725	11.58	[10.81; 12.39]
Physical	501	8.02	[7.38; 8.72]
Sexual	123	1.96	[1.65; 2.34]
Suffering violence			
Bullying	1702	27.11	[26.03; 28.23]
Verbal	1044	16.71	[15.80; 17.65]
Physical	535	8.55	[7.89; 9.27]
Sexual	134	2.14	[1.81; 2.53]
9-month follow-up measures			
Practicing violence			
Bullying	920	22.00	[20.77; 23.29]
Verbal	632	15.11	[14.05; 16.23]
Physical	368	8.83	[8.01; 9.73]
Sexual	54	1.29	[0.99; 1.68]
Suffering violence			
Bullying	1361	32.51	[31.11; 33.95]
Verbal	895	21.40	[20.18; 22.67]
Physical	343	8.27	[7.47; 9.15]
Sexual	49	1.17	[0.89; 1.55]

9 months after baseline. The data showed that most students were girls (51.21%), between the ages of 11 and 12 (53.83%) who belonged to the middle socioeconomic class (53.98%). The most frequently drug used by participants over the previous month at baseline was alcohol (16%), and the most prevalent type of violence suffered and perpetrated was bullying (27% for bullying victimization, and 18% for bullying perpetration). At the follow-up, bullying was still the most prevalent type of violence (22% for bullying perpetration, and 32% for bullying victimization).

Confirmatory Factor Analysis of Violence

The unidimensional model for school violence at baseline and after 9 months showed the following fit indices: CFI = 0.951, RMSEA = 0.061 (95% CI 0.056–0.065) at baseline and CFI = 0.926, RMSEA = 0.067 (95% CI 0.062–0.073) after 9 months.

After a minor adjustment of residual variance for items with the same meaning in terms of the nature of the violence, the fit indices found for both time points were CFI = 0.954, RMSEA = 0.064 (95% CI 0.059–0.069) at baseline and CFI = 0.942, RMSEA = 0.064 (95% CI 0.058–0.071) after 9 months, indicating that they were acceptable models.

Linear Regression

Table 2 shows the magnitude (coefficient) and statistical significance (p-value) of the predictors (violence at baseline, alcohol, tobacco, inhalants, marijuana, cocaine, group, sex, age, and SES) of involvement in violent episodes at school. Given that this was an RCT, the randomization group was forcibly included in the final model, and no effect of the program was identified ($\beta = 0.047$, $p = 0.377$, CI = [−0.058; 0.153]).

We found that violence at baseline was a predictor of more violence after 9 months ($\beta = 0.397$, $p < 0.001$, CI = [0.348; 0.445]), i.e., adolescents involved in previous violent events were more involved in those events over time. Additionally, inhalant use ($\beta = 0.358$, $p = 0.026$, CI = [0.042; 0.674]) was associated with greater involvement in violent episodes at school after 9 months—regardless of whether they were victims or perpetrators of violence. This result was independent of the violence detected at baseline, as it remained significant after controlling for SES.

Regarding the sociodemographic variables, being a girl was less associated with both victimization and perpetration of violence than being a boy ($\beta = -0.144$, $p < 0.001$, CI = [−0.221; −0.067]). In other words, sex predicted violence, and boys were more involved in violent episodes than girls.

Table 2 Summary of linear regression analysis for variables on baseline predicting violence score after 9 months, controlling for sociodemographic variables (group, gender, age, and SES)

Outcome	Predictors (T1)	Coef	Standard error's coef	p-value
School violence (T2)	Violence	0.397	0.025	<0.001
	Alcohol	0.269	0.143	0.059
	Binge drinking	−0.175	0.177	0.323
	Tobacco	−0.061	0.280	0.829
	Inhalants	0.358	0.161	0.026
	Marijuana	0.139	0.245	0.569
	Cocaine	−0.542	0.695	0.435
	Group	0.047	0.054	0.377
	Gender	−0.144	0.039	<0.001
	Age	0.001	0.024	0.962
	SES	0.005	0.004	0.208

Discussion

This study analyzed whether drug use predicted violent behaviors among adolescents in Brazilian schools after controlling for previous occurrence of violence, sociodemographic variables, and randomization group. It was hypothesized that adolescents who used alcohol, tobacco, and other drugs would perpetrate and be victims of more violence at school than those who did not. We found that involvement in violent episodes and the use of inhalants at baseline predicted higher levels of violence after 9 months. Additionally, being a boy predicted a greater chance of being involved in violent acts. The strength of this study is that it assessed the type of violence perpetrated and suffered as a score using a unique, validated construct. Thus, by considering violence intensity, we can correlate drug use and history of violence with later involvement in violent episodes, even after controlling for the randomization group effect in an RCT.

Our findings in Brazil, a middle-income country, are in accordance with previous studies in schools from developed countries, indicating that the best predictor of future violence is a history of violence, regardless of whether it is perpetrated or suffered (Farrington et al. 2011; Herrenkohl et al. 2012). One possible explanation for this phenomenon is that individuals who have personal traits of aggressiveness or impulsiveness as well as difficulties with self-control are more likely to engage in later acts of aggression and violence if no intervention to reduce this pattern is provided (Loeber and Stouthamer-loeber 1998). Additionally, previous research has shown that victims of school violence have a tendency to experience more victimization later in life (L. Arseneault et al. 2010). Thus, implementation of evidence-based prevention programs that target impulse control in early childhood, such as the Good Behavior Game (Tingstrom et al. 2006), is crucial. Importantly, data from this study came from an RCT to evaluate a drug prevention program. However, analyses were controlled for the non-effect of the program, and all results were independent of the assigned group.

Our finding that previous inhalant use predicted more violence is consistent with previous studies using isolated observed variables (Ellickson and McGuigan 2000; Gilreath et al. 2014; Weiner et al. 2005). The ingestion of such substances may cause a disinhibiting effect in the individuals who use them, facilitating the perpetration of violence (Boles and Miotto 2003). Despite the disinhibiting effect also seen for other drugs, such as alcohol (Graham 2003), what differs between the two drugs is that involvement with inhalants is usually identified as a transgression, since it is an intermediate drug from licit to illicit (Sanchez et al. 2013); that is, considering that alcohol use is much more prevalent and socially accepted, the psychological profile of an adolescent who uses only alcohol is different from those who decide to go a step further and initiate the use of inhalants. For this reason, these substances can be considered good "markers" for adolescent disruptive profiles, as previously discussed by Sanchez et al. (2013). It is important to mention that inhalant use as a potential predictor of violence is not influenced by the adolescent SES. One potential explanation is that, according to Sanchez et al. (2013), different sorts of inhalants are used in different SES, but are used by all socioeconomical groups. For instance, adolescents in low-income groups tend to use glue, while those in high-income groups might use nail polish/acetone, gasoline, *loló*, and *lança-perfume* (a blend of ether and chloroform). Notably, little research has been conducted on inhalant use in Brazil, although the use of this drug is prominent among adolescents in the country, with a lifetime prevalence of 9% among 10- to 17-year-old students (Nappo et al. 2012). Thus, an important consideration when preventing school violence is to consider the program's effectiveness to prevent inhalant use, as found in several school prevention

programs' evaluation research (Botvin et al. 2001; Gabrhelik et al. 2012; Griffin et al. 2003; Sanchez et al. 2018). Additionally, policy makers should also promote environmental strategies that focus on school and learning climates and on policies that address descriptive and injunctive norms (EMCDDA - European Monitoring Centre for Drugs an Drug Addiction 2018).

In addition to the findings from this study, it is important to consider that mental illness is a risk factor common to both drug use and violence. It is known that individuals with mental illness are more likely to engage in violent events as victims or perpetrators (Choe et al. 2008). Additionally, psychiatric patients may be more susceptible to alcohol and other drug use disorders due to the features of their mental disease (Volavka and Swanson 2010). Thus, since the present study does not measure the occurrence of mental illness, we suggest that further studies consider this variable to analyze mediating effects between the three risk factors.

Another important consideration is that the drug prevention program #Tamojunto had no effect on violence after 9 months. We retained this variable in the analysis to control for a possible confounding effect, as it was an RCT. Our result contrasts with that of a previous study regarding the effects of #Tamojunto, in which the program was shown to be a protective factor for bullying victimization among girls aged 13 to 15 years within 9 months of program completion (Gusmões et al. 2018). This difference may have occurred because the previous study analyzed the perpetration and victimization of bullying and physical violence separately. Thus, the effect possibly loses its significance when all types of violence as well as perpetration and victimization are analyzed together, as they were in the present study.

Regarding the sociodemographic variables, the finding that being a boy increased the perpetration and victimization of school violence aligns with the findings of several authors in different countries (Ellickson and McGuigan 2000; Gilreath et al. 2014). This may be because problems in impulse control are more frequent in men (Knežević 2018), making them more vulnerable to violent behavior (Vetten and Ratele 2013) and more prone to the effect of programs such as GBG (Petras et al. 2008). The reason for this difference between sexes may be that boys and girls react differently to certain individual and environmental characteristics (Ellickson and McGuigan 2000). For example, Jalón Díaz-Aguado and Arias (2013) indicated that men tend to be more aggressive due to differences in socialization, expectations regarding gender structures, and the roles of men in the community.

This study has some limitations that should be considered. The primary limitation was student absences from school, which compromised the data collection and may indicate a possible selection bias. One study indicated that the absence rate is approximately 20% per day in public schools in Brazil (Instituto Brasileiro de Geografia e Estatística 2015), which explained our initial difference in the number of potential recruits and actual participants. Another limitation was the use of an individual questionnaire as the instrument, as the answers may have been subject to information bias due to incorrect interpretation, intention to report the truth, or testing bias through repetition during the two time points. Additionally, our analysis does not provide information on the order in which drug use and violent behavior occur since the inverse pathway (from violence to substance use) was not tested. Thus, we suggest performing further studies to complement this study to understand which behavior appears first during adolescence.

The results of this study suggest that among adolescents the use of inhalants and previous involvement in violent events seem to be predictors of higher violence perpetration and victimization after 9 months. The results reinforce the importance of having programs that address lack of impulse control as a precursor of both substance use and violence. Inhalant use

should be considered a marker for future disruptive behavior, independently of previous episodes of violence. Thus, we suggest that prevention programs should also consider the use of inhalants to reduce violent behaviors in schools.

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Declarations All procedures in our study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and later amendments or comparable ethical standards. This study was approved by the Ethics in Research Committees at the University of São Paulo (#473.498), and supported by the Brazilian Ministry of Health (grant number TED 89/2014).

Conflict of Interest The authors declare no competing interests.

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Affiliations

Julia D. Gusmoes[1] · Juliana Y. Valente[1] · Hugo Cogo-Moreira[2] · Zila M. Sanchez[1]

[1] Department of Preventive Medicine, Universidade Federal de São Paulo, Rua Botucatu, 740, 4° Andar, São Paulo, SP, Brazil

[2] Department of Psychiatry, Universidade Federal de São Paulo, Rua Pedro de Toledo, 669, 3° Andar (Fundos), São Paulo, SP, Brazil