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ORIGINAL CONTRIBUTION

Evaluating the effects of parenting styles dimensions on adolescent drug use: secondary analysis of #Tamojunto randomized controlled trial

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Abstract
The present study examined parenting style dimensions (demandingness and responsiveness) as predictors of adolescent drug use and also evaluated whether parenting styles dimensions moderate the effects of the implemented prevention program. 6.391 students in the 7th and 8th grades at 72 Brazilian public schools participated in a three-wave randomized controlled trial to evaluate a school drug-use prevention program. We used structural equation modeling to test if baseline parenting style dimensions (demandingness and responsiveness) would predict the use of drugs (alcohol, binge drinking, cannabis, inhalants, and tobacco) after 21 months. Additionally, we evaluated an interaction version of the above-described model to test if the effect of the prevention program would be moderated by either or both parenting style dimensions. Higher levels of parent demandingness predicted lower chances of adolescent drug use (e.g., Cigarette use OR 0.76, 95% CI 0.64–0.89); responsiveness on the five outcomes showed p value superior to 0.01. The effect of the #Tamojunto intervention is unlikely to be conditioned to either parenting style dimensions on the assessed outcomes.
Clinical trial registration Brazilian Register of Clinical Trials (REBEC): #RBR-4mnv5g (https://www.ensaiosclinicos.gov.br/rg/?q=tamojunto).

Keywords Adolescence · Drug use · Confirmatory factor analysis · Parenting style · Moderation · Randomized controlled trial

Introduction

Adolescent drug use is a growing global health priority and a condition that can lead to many health risks and social consequences [1]. To prevent harm and reduce the global impact of early drug use, it is important to identify the predictors of this behavior [2]. The family environment is one of the most influential domains for drug use among adolescents, and parenting styles are a common way of studying this domain [3].

In general, the classification of parenting style is derived from the Baumrind [4] and Maccoby and Martin [5] conceptualization, defined by the combination of two parenting style dimensions: responsiveness, defined as being supportive and warm; and demandingness, defined as parental supervision and monitoring. Studies have indicated that high levels of both dimensions are protective against adolescent substance use, while low levels are associated with elevated rates of drug use by adolescents [6, 7]. However, the discussion about which domain is more protective remains inconclusive and the answer may vary from culture to culture [8]. In addiction, most studies look at parenting styles with no consideration of their continuous dimensionality (in terms of demandingness and responsiveness), categorizing parents into four discrete groups based on the combination of parenting style dimensions (authoritative, authoritarian, permissive and negligent) treated as present/absent or high/low binaries [9]. Statistically, dimensional covariates are always preferable to those categorized under arbitrary procedures (e.g.,

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median as cutoff, as it generally adopted to create parenting groups).

Together with the application of protective parenting styles, another way to reduce or delay the onset of drug use among adolescents is through the implementation of school-based prevention programs [10]. However, most implemented prevention programs have never been evaluated for efficacy, and even of those evaluated, most do not reduce or delay consumption or otherwise show positive iatrogenic results [11]. A meta-analysis found that only a prevention program that measured drug use as a continuous variable showed small positive effects of school-based preventive interventions on adolescent alcohol use; nevertheless, tests of heterogeneity showed a significant variance in effect size across studies leaving the generalizability of findings in doubt [10].

In Brazil, the Ministry of Health conducted a transcultural adaptation and implementation of the unplugged program, renamed #Tamojunto. Unplugged is a school-based drug prevention program based on the "Model of Global Social Influence", which is intended to strengthen the personal and interpersonal skills of adolescents to reduce the social influence fostering adolescent drug use [12]. In European countries, unplugged yielded significant reductions in episodes of recent drunkenness and frequent cannabis use among adolescents [13]. In Brazil, evaluations of effectiveness were more mixed, showing that #Tamojunto seemed to increase first alcohol use and decrease first inhalant use in the intervention group compared to the control group [14].

These findings highlight the need for a well-conducted evaluation of adolescent substance use prevention programs that can justify public support for and investment in them [10] and also points to the necessity of robust analyses to identify whether prevention programs are equally effective across diverse groups of adolescents [15]. One potential reason for heterogeneity and null effects is that prevention programs may be differentially effective with specific groups of adolescents, requiring more attention to moderators that can influence participants' response to preventive intervention [10]. Such moderating variables can affect the relationship between the intervention and the results, increasing, reducing or changing the effect of the intervention [15].

Some studies have begun to examine possible moderators of the effects of interventions based on the analysis of risk and protection factors related to drug use among adolescents [16]. Despite the evidence for the roles of parenting styles as risk and protection factors, as described above, there is a lack of studies analyzing their influence as moderators of the effect of prevention programs targeting only adolescents [17, 18].

Given the importance of parental influence for the prevention of adolescent drug use, we examined the effect of parenting style dimensions (demandingness and responsiveness) as predictors of adolescent drug use. The study's first hypothesis is that low levels in parenting styles dimensions will predict adolescents' drug use, independently of the intervention effect. In addition, the second aim of the present study is to evaluate whether parenting styles dimensions moderated the effects of the #Tamojunto prevention program. The study's second hypothesis is that the effect of intervention on adolescents' past-year drug use would be higher among those students' whose parents own higher levels of responsiveness and demandingness parenting styles dimensions will serve as moderators of intervention effects.

Methods

Study design

A two-group parallel-arm school-clustered randomized controlled trial was conducted to compare the integration of the prevention program #Tamojunto into school curricula (intervention condition) with the usual curriculum in Brazil, sporting no prevention program (control condition), among students attending 7th and 8th grade (12–13 years of age) in public schools in six Brazilian cities (São Paulo, Federal District (Brasília), São Bernardo do Campo, Florianópolis, Fortaleza, and Tubarão), located in four Brazilian states. The trial registration protocol at the national Brazilian Register of Clinical Trials (REBEC) is #RBR-4mnv5g.

From a sample universe of all public schools in the participating cities (according to the national registration list of schools from the Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira), 72 schools were randomly selected, proportional to the number of schools in the municipality (stratum). Among the schools selected to participate, a second allocation, according to a random list, determined whether each school would be assigned to the control or intervention group, maintaining a 1:1 allocation ratio per municipality. Randomization was performed at the school level, via the Excel macro [command RAND].

In the intervention schools, students received 12 lessons of the #Tamojunto program substituted in place of the normal curriculum, while the control schools faced no alteration in their curriculum, which does not implement any prevention program. The cultural adaptation and implementation of the program were responsibilities of the Brazilian Ministry of Health (BMH). Evaluation was conducted by independent researchers.

Data were collected simultaneously in the control and intervention schools at three time points (Fig. 1). The first follow-up was conducted at the end of the school year to avoid likely loss to follow-up due to summer vacation. This study was approved by the Ethics in Research Committees

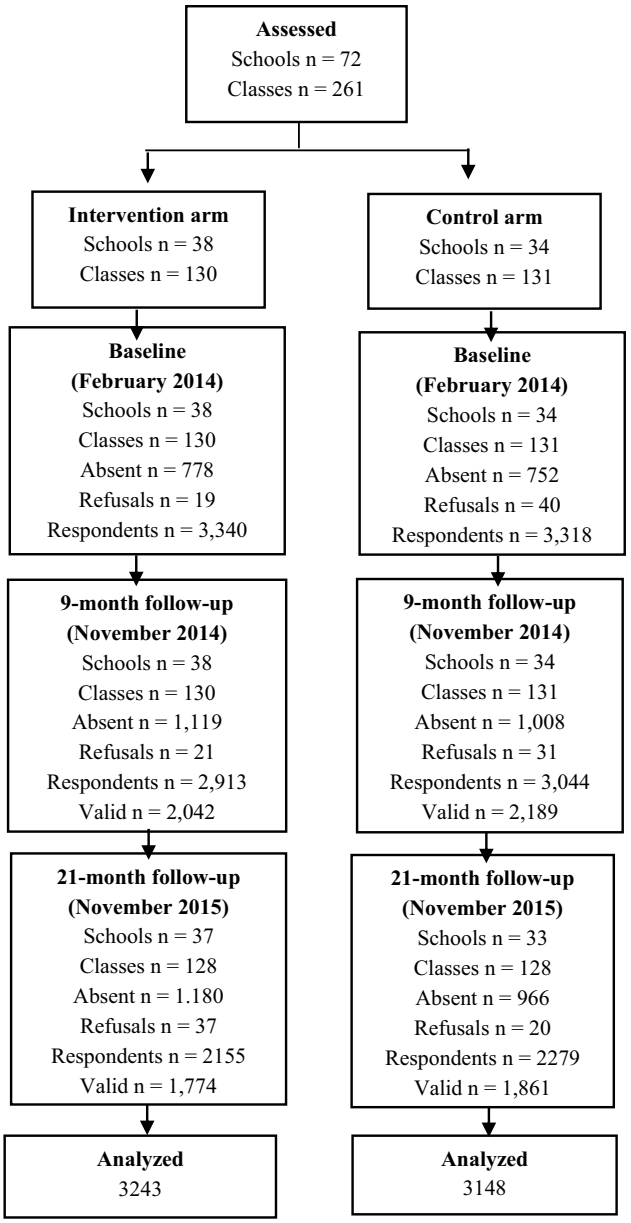

Fig. 1 Flowchart of total sample data and sample from baseline (2014) and 9-month follow-up. Absent = absent from school on the day of the assessment. Refusals = refused to participate in the assessment. Valid = number of subjects used in the cross-sectional analysis. Respondent = assenting to participate, providing data

at the University of São Paulo (#473.498) and the Federal University of Santa Catarina (#711.377).

Population and sample size

Based on the sample size calculation, to achieve a power of 80% and a significance level of 5% for a difference between groups of 1.5 percentage points (e.g., from 5 to 3.5%), the necessary sample size for each study arm was calculated to be 2835, with a ratio of 1:1. To account for losses to follow-up and for high intraclass correlation, this number was increased by 50% to a recruitment target of 4253 participants in each arm. Details on sampling procedures are presented in previous studies [19].

The sample consisted of 6391 adolescents [51% females, average age = 12.62 years old, standard deviation (SD) = 0.825, ranging from 11 to 15 years old at the baseline]. Table 1 shows the frequency of drugs use in the two waves (baseline and 21 months after the intervention) together with missing values. The mean of demandingness was 8.36 (SD 3.51; ranging from 0 to 12, where the higher score, the more demandingness) and for responsiveness 14.04 (SD 5.62; ranging from 0 to 20, where the higher score, the more responsiveness).

Intervention

The Unplugged program was first designed by the EU-DAP (European Drug Addiction Prevention Trial) group [20]. It consists of 12 classes (4 one-hour classes on attitudes and knowledge about drugs, 4 classes on social and interpersonal skills, and 4 classes on personal skills), 50 min long, applied to students by teachers trained and guided by the student and teacher Unplugged manuals. Both manuals are open access and are available in several languages on the website www.eudap.net.

A BMH team performed the translation and transcultural adaptation of the program under the supervision of the European developers, in 2013. The English version of the unplugged material was translated into Portuguese, retaining the original format and subjects (educational strategies provided in 12 classes and 3 parent workshops) but with adapted activities. Given the epidemiological profile of illegal drug use among students in Brazil, information on heroin was replaced with information on crack cocaine. Further details of the cultural adaptation process are described elsewhere [21].

The teachers who delivered the program attended a 16-hour training program facilitated by coaches trained by the European developers, the master trainers of the EU-DAP Intervention Planning Group [13]. At the end of each class, teachers completed a fidelity questionnaire to assess the dose of the program delivered. To guarantee fidelity and dose, teachers were supervised monthly by the same coaches from the BMH who had facilitated the initial training.

Instrument and variables

The instrument used for data collection had been developed, tested and implemented previously by the EU-DAP [13]. In Brazil, we used an adapted version of the questionnaire, translated into Portuguese [22]. The questionnaire evaluates

Table 1 Proportion of past-year drug use in the intervention and control groups across time

	Control			Unplugged		
	No (valid %)	Yes (valid %)	Missing %	No (valid %)	Yes (valid %)	Missing %
Baseline						
Alcohol	2126 (67.5)	1001(31.8)	21 (0.7)	2203 (67.9)	1014 (31.3)	26 (0.8)
Binge	2633 (83.6)	487 (15.5)	28 (0.9)	2682 (82.7)	519 (16.0)	42 (1.3)
Cigarette	3005 (95.5)	115 (3.7)	28 (0.9)	3080 (95)	128 (3.9)	35 (1.1)
Inhalants	2867 (91.1)	254 (8.1)	27 (0.9)	2935 (90.5)	271 (8.4)	37 (1.1)
Cannabis	3050 (96.9)	73 (2.3)	25 (0.8)	3121 (96.2)	83 (2.6)	39 (1.2)
21 months						
Alcohol	1005 (31.9)	849 (27.05)	1294 (41.1)	889 (27.4)	882 (27.2)	1472 (45.4)
Binge	1384 (44.0)	460 (14.6)	1304 (41.45)	1312 (40.5)	448 (13.8)	1760 (54.3)
Cigarette	1724 (54.8)	122 (3.9)	1302 (41.4)	1629 (50.2)	130 (4.0)	1484 (45.8)
Inhalants	1643 (52.2)	202 (6.4)	1845 (58.6)	1589 (49.0)	175 (5.4)	1764 (54.4)
Cannabis	1713 (54.4)	133 (4.2)	1302 (41.4)	1611 (49.7)	143 (4.4)	1489 (45.9)

a set of variables including sociodemographic data and past-month (yes/no) and past-year (yes/no) use of alcohol, tobacco, marijuana, inhalants, powder cocaine, and crack. It also evaluates the practice of binge drinking (the consumption of five or more alcoholic drinks on a single occasion) in the past month and past year. Socioeconomic status (SES) was assessed using a scale from the Brazilian Association of Research Companies (ABEP) [23]. The outcomes analyzed were past-year use of alcohol, tobacco, marijuana, inhalants and binge drinking at the three time points (baseline, 9 months after and 21 months after the baseline).

To pair (link) the questionnaires on each subject, students filled in a secret code involving letters and numbers created from their first name, surname, date of birth, mother's name, father's name, and maternal grandmother's name. Each code was composed of eight characters (7 letters and one number) and could only be decoded by the students themselves. These codes allow researchers to link individual questionnaires at different times of the study while protecting the anonymity and confidentiality of the participants [24]. The secret codes were matched using the Levenshtein algorithm, which identifies similarities among a set of characters; school and class codes were included in the matching process [25]. To avoid overreporting, questionnaires that were positive for lifetime use of a fictional drug (Holoten or Carpinol) were excluded from the analysis.

In the present study, outcome variables were used from wave 3 (21-month follow-up): Occurrence (yes/no) of alcohol use, tobacco use, marijuana use, inhalant use, and binge drinking within the past year was assessed the 5 questions, such as "From one year to the next, i.e., in the last 12 months, have you drunk alcoholic beverages?".

The assessed explanatory variables (predictors) used were three sets of variables from the wave 1 (baseline) data assessment: control variables: age, gender, 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 students' SES was assessed using the scale of the Brazilian Association of Research Companies [23], which takes into account the education of the head of the household and the goods and services consumed, with scores ranging from 0 to 46 or in categories from A to E; higher scores indicate better economic standing, and SES is ranked from A (highest) to E (lowest).

The moderating variables used were the two latent dimensions of parenting style (demandingness and responsiveness) from wave 1 (baseline). The data relating to parenting styles were collected through a questionnaire completed by the students who evaluated their parents on the two dimensions (demandingness and responsiveness); evidence for validity based on the internal consistency is shown in supplementary material (Figure S1.) The instrument consists of two ordinal scales that respectively measure the orthogonal dimensions of demandingness (six items) and responsiveness (ten items), each assessed by means of a three-point Likert type on which values closer to three indicate greater perceived demandingness or responsiveness [26].

Statistical analysis

To test the two hypotheses, we used a structural equation modeling (SEM) approach. For the first hypothesis, we tested if parents' demandingness and responsiveness dimensions (estimated via confirmatory factor analysis) would predict their adolescent children's past-year use for five different drug types (alcohol, binge drinking, cannabis, inhalants, and cigarettes) after 21 months of intervention. For the second hypothesis, we evaluated an interaction version of the above-described model (also called an interaction model), where the effect of the proposed intervention would be conditioned

to parents' behaviors on both dimensions (also estimated via confirmatory factor analysis).

The analysis had two steps:

1. The two behavioral dimensions of parents were estimated via confirmatory factor analysis. The following fit indices were used to evaluate the model: chi-squared, comparative fit index (CFI), Tucker–Lewis Index (TLI), root–mean–square error of approximation (RMSEA), and weighted root mean square residual (WRMR) [27]. Using confirmatory factor analysis, missing values are dealt with using full-information maximum likelihood. In this way, we preserve as much information as possible by not excluding subjects if they have only one single missing datum out of the 16 questions about parents' perceived behavior.
2. The two latent factors were used as predictors of drug use together with control variables. For the interaction model, we added to the covariates two interaction terms: demandingness × group and responsiveness × group. It is important to note that the created interaction terms are products of continuous latent variables (demandingness and responsiveness) with a dichotomous observed variable. We assumed a correlated factor model, because it is a default to assume that both domains would be correlated. In Mplus, interaction between a continuous latent variable and an observed categorical variable is conducted using a Model Command called XWITH.

For the attrition analysis, we compared students whose data from the two time points had been matched with students who answered only the baseline questionnaire (See Table S1 Supplementary file).

Dealing with missing data

In this longitudinal study, some data were missing on different variables (outcomes, moderators). Therefore, we employed a procedure to deal with such missingness called full information maximum likelihood (FIML), in which each parameter is estimated directly without first filling in missing data values, assuming that the missing data mechanism is missing at random (MAR); MAR mechanism occurs "[when] the probability of missing data on outcome variable is related to another measured variable in the analysis model but not to the value of the outcome itself" (Enders, 2010, page 11), [28] having an unverifiable assumption, differently of missing completely at random (MCAR) mechanism and its testable inference Little's MCAR test. FIML estimates a likelihood function for each individual based on the variables that are present so that all the available data are used. Moreover, FIML is invoked by the estimator called robust maximum likelihood, which is efficient compared to the other methods (i.e., multiple imputation) of dealing with missing data under the assumption of missing at random (MAR) mechanism [29]. Even if the data MCAR, FIML is still superior to other traditional techniques by maximizing the statistical power [28].

The robust version of maximum likelihood was used as estimator throughout all the analysis, which allowed to generate standard errors taking into account non-independence due to the cluster structure in the data (i.e., adolescents nested in 72 schools) using the implementation proposed by Asparouhov [30]. Due to the five dichotomous outcome being evaluated concomitantly, the adopted significance level was $0.05/5 = 0.01$.

Results

Fit of two correlated factor model

The model fit indices indicated that our model, constituted by observed and latent variables, has a good fit, as follows: $\chi^2 = 1518.249$, $p < 0.001$, RMSEA = 0.050, CFI = 0.940, TLI = 0.929, WRMR = 2.377. The distribution of the two dimensions can be found in Figure S1, Supplementary file.

Figure 2 depicts the linear tested statistical model, consisting of two factors (demandingness and responsiveness) both regressed on five different outcomes separately together with the following observed covariates: age, sex, SES, group assignment, and baseline assessment of the outcome under evaluation. Figure 3 shows the interaction model, with two added interactions variables called int1 [demandingness × group] and int2 [responsiveness × group]. Because Fig. 2, the linear model, has an outcome of alcohol use after 21 months, the baseline assessment on alcohol use was added as a covariate.

Predictors of factor dimensions

Table 2 shows the predictions (in odds ratios) of the linear and interaction models for the two parenting style dimensions presented with their respective confidence intervals [95%] and *p* values.

Under the FIML, with regard to the first hypothesis (the linear model), demandingness was associated with lower chances of binge drinking (OR 0.88, [95% CI 0.80–0.96], tobacco use (OR 0.76, [95% CI 0.64–0.89], and inhalants use (OR 0.81, [95% CI 0.72–0.91]. None of the p values regarding the effect #Tamojunto on adolescents' drug use were inferior to 0.01. Responsiveness showed to be unlikely predicting adolescents' drug use.

Regarding the second hypothesis, all the interaction effects on parents' behaviors and group assignment on the five outcomes had p values superior to 0.01. Our sample

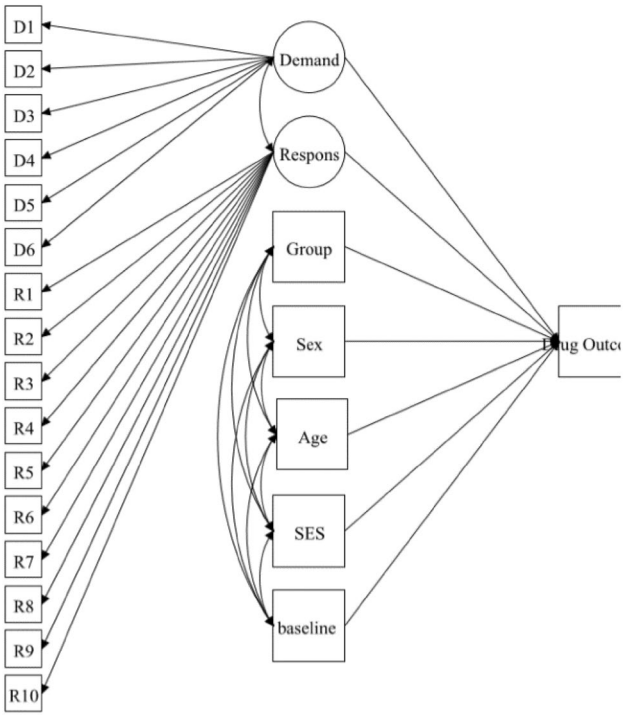

Fig. 2 Linear statistical model. Parental Demandingness: How much do YOUR PARENTS TRY to know …: D1: What you do with your friends? D2: What you do with your free time? D3: Where were you most afternoons after school? How much do your parents REALLY know …: D4: What you do with your friends? D5: What you do with your free time? D6: Where were you most afternoons after school? Parental Responsiveness: About YOUR PARENTS consider the following items…R1: I can count on them to help me out, if I have some kind of problem. R2: They keep pushing me to do my best in whatever I do. R3: They keep pushing me to think independently. R4: They help me with my school work if there is something I do not understand. R5: When they want me to do something, they explain me why. R6: When I get a good grade in school, they praise me. R7: When I get a poor grade in school, they encourage me to try harder. R8: They really know who my friends are. R9: They spend time just talking with me. R10: My family does something fun together

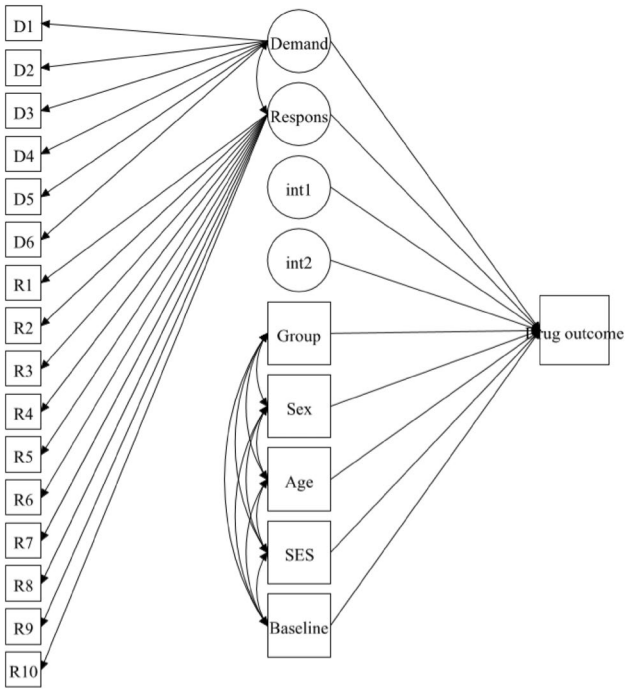

Fig. 3 Interaction statistical model. Parental Demandingness: How much do YOUR PARENTS TRY to know …: D1: What you do with your friends? D2: What you do with your free time? D3: Where were you most afternoons after school? How much do your parents REALLY know …: D4: What you do with your friends? D5: What you do with your free time? D6: Where were you most afternoons after school? Parental Responsiveness: About YOUR PARENTS consider the following items…R1: I can count on them to help me out, if I have some kind of problem. R2: They keep pushing me to do my best in whatever I do. R3: They keep pushing me to think independently. R4: They help me with my school work if there is something I do not understand. R5: When they want me to do something, they explain me why. R6: When I get a good grade in school, they praise me. R7: When I get a poor grade in school, they encourage me to try harder. R8: They really know who my friends are. R9: They spend time just talking with me. R10: My family does something fun together

size and sampling features (i.e., ICC) allow us to identify interaction effects with magnitude ranging below than moderate effect sizes. This means that the effects of the proposed intervention are really unlikely to be conditioned to either parenting style dimensions or if they exist, they have a very small effect, which would be not meaningful.

Attrition

Most of the students that were lost in at least one time point of follow-up reported higher prevalence of drug use in the baseline, were older and more assigned to the intervention group (Table S1, in Supplementary file).

Discussion

This study is the first, as far as we could determine, to investigate parenting style dimensions (demandingness and responsiveness) as predictors of adolescent drug use and as moderators of the effect of a school-based drug use prevention program. The linear model confirmed partially our first hypothesis that higher levels of parent demandingness predicted lower chances of adolescent drug use. However, the second hypothesis, that #Tamojunto would have stronger effects in students who reported parents with high demandingness and responsiveness, was not supported. Therefore, the intervention's effects on drug use at the third wave seem to be unlikely conditioned by either parenting style dimensions.

Table 2 The linear and the interaction model considering the moderator from baseline (analysis controlled by age, sex, SES, group, and baseline measures)

	Outcomes	Odds ratio (95% CI)	*p*	Odds ratio (95% CI)	*p*	Odds ratio (95% CI)	*p*	Odds ratio (95% CI)	*p*
		Int1 (demandingness × group)		Int2 (responsiveness × group)		Demandingness		Responsiveness	
Linear model	Alcohol ($n=6103$)					0.94 (0.86–1.01)	0.104	0.99 (0.93–1.05)	0.742
	Binge ($n=6084$)					**0.88 (0.80–0.96)**	**0.006**	0.96 (0.90–1.03)	0.254
	Cigarette ($n=6087$)					**0.76 (0.64–0.89)**	**0.001**	1.05 (0.93–1.18)	0.458
	Inhalant ($n=6089$)					**0.81 (0.72–0.91)**	**< 0.001**	1.02 (0.94–1.12)	0.592
	Cannabis ($n=6092$)					0.83 (0.70–0.98)	0.018	0.98 (0.86–1.12)	0.764
Interaction model	Alcohol ($n=6103$)	0.99 (0.85–1.16)	0.922	1.07 (0.95–1.21)	0.258	0.94 (0.85–1.04)	0.243	0.96 (0.88–1.04)	0.293
	Binge ($n=6084$)	0.85 (0.72–1.00)	0.057	1.08 (0.95–1.22)	0.227	0.95 (0.84–1.08)	0.440	0.93 (0.85–1.01)	0.085
	Cigarette ($n=6087$)	0.95 (0.69–1.32)	0.773	0.95 (0.75–1.21)	0.687	0.77 (0.59–1.00)	0.052	1.07 (0.89–1.30)	0.455
	Inhalant ($n=6089$)	0.939 (0.744–1.184)	0.595	0.897 (0.764–1.05)	0.185	0.83 (0.70–0.97)	0.023	1.08 (0.95–1.23)	0.235
	Cannabis ($n=6092$)	0.936 (0.683–1.281)	0.678	1.009 (0.776–1.31)	0.950	0.85 (0.67–1.08)	0.194	0.98 (0.79–1.20)	0.823

This paper shows association between lower parenting demandingness and higher adolescent drug use, regardless of preventive intervention. This result seems to contradict the previous literature that considered parenting styles as four categories (authoritative, authoritarian, permissive and negligent) since it shows that only one dimension of parenting style (demandingness, not responsiveness) acts as a protective factor against adolescent drug use. Studies have indicated that authoritative parenting (combining high levels of demandingness and responsiveness) is the most protective parenting style against adolescent substance use [6] and was also associated with greater offspring emotional well-being and fewer depressive symptoms [31]. On the other hand, previous studies already suggested that the association between parenting styles and drug use may vary from culture to culture [8, 32] and in Brazilian culture being supportive and warm is not so important as parental supervision and monitoring. One possible explanation is the lack of drug control policies and the unregulated alcohol market in Brazil [33, 34]. Thus, the role of Brazilian parents in monitoring their children becomes more relevant on drug prevention.

Considering that parenting demandingness refers to parental control of children's behavior and actively monitoring and supervising a child's activities [4], this result is in line with previous studies carried out in other countries, which found that monitoring parenting (which has very similar concept to "demanding" parenting styles in this study) is a protective factor for adolescent drug use [3]. Our result highlights the importance of the parenting demandingness dimension in the prevention of adolescent drug use. Considering that parenting interventions tend to produce small to moderate effects on adolescent substance use [35], addressing parenting behaviors shown to be strong predictors of adolescent drug use might magnify the effect of these prevention programs. However, parental demandingness or monitoring must be distinguished from harsh, psychologically abusive control, which has been shown to be strongly associated with externalizing problems [36].

Despite the already known negative [14] findings on #Tamojunto as a universal program for alcohol and drug use, our second hypothesis reflected the possibility that by testing for specific subgroups or moderators we might be able to find a selective effect. This hypothesis was based on the idea that the students whose parents present high demandingness and responsiveness should be more able to take advantage of prevention program lessons, as previous studies have shown that parenting styles affect school performance [37] and adaptive achievement strategies [38]. However, the unlikely moderating effects we found of parenting styles dimensions on the effect of #Tamojunto were contrary to our second hypothesis. Although many studies demonstrate the importance of parenting skills on offspring's drug use, we found no other studies evaluating the moderating role of parenting on drug use prevention programs targeting adolescents—only previous studies that evaluated the moderating effect of parenting skills training programs on adolescent drug use [17, 18]. It is important that more studies be implemented in this area, as more knowledge could help us understand the importance of parenting skills for general drug use prevention programs.

We must say that this lack of evidence on moderation effect of #Tamojunto is in line with previous studies that evaluated the direct effect of the program and also showed negative [14] effects, despite the positive results of the similar unplugged prevention program in European contexts—reducing episodes of recent drunkenness and frequency of cannabis use among adolescents [13]. The possible explanations include poor adherence to the curriculum [39], flawed cultural adaptation [14], and the weak regulatory framework controlling the sale and promotion of alcohol in Brazil [33].

This study has some limitations that should be considered. First, there was an excessive amount of missing data, especially from follow-up measures. However, the absence of some data is an expected limitation in longitudinal studies, especially those with long follow-up periods [40]. FIML and the assumption of MAR borrow information from the observed data maximizing the statistical power. FIML is not imputing the missing values, differently of other procedures to deal with missing data, as for example, multiple imputation [41]. FIML yield unbiased parameter estimates with MAR and allow us to follow the principle of intention-to-treat where all the randomized participants were analyzed. However, the inspection of the covariance coverage showed that none of the coverage was below 30%, being the minimum limit default in Mplus of 10%: for covariance coverage below such value, Mplus stops the analyses. We hope that this was adequately addressed using full-information maximum likelihood. Second, we only collected measures provided by the adolescents; thus, we assessed only the adolescents' perceptions of parenting style. It is common practice to use adolescents' perceptions of parenting behaviors as a categorical observed covariate, as we did [42]; nevertheless, studies that assess the perceptions of both parents and children simultaneously tend to provide more reliable data on parenting styles and drug use, as adolescents tend to have a more negative perception than parents regarding the parent–child relationship [43].

In conclusion, we observed parenting demandingness (monitoring) skills, per se, reduced slightly the chance of drug use and such reduction, being very unlikely to be conditioned to the #Tamojunto. Therefore, the potential hypothesized "booster" of the parenting behaviors on drug use among those who received intervention was not identified. Importantly, it is of note that the lack of significance of the interaction model is also valid for the other side of the dimension of parenting (low levels of demandingness and responsiveness) where those adolescents who did not receive the intervention do not use more drugs, given that their parents have low levels of demandingness and responsiveness.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Human participants and/or animal subjects All procedures in the present study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its 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 the Federal University of Santa Catarina (#711.377).

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