

# Six-month follow-up of the 'Mi Mejor Plan' school-based prevention program: a pilot cluster randomized controlled trial among adolescents in Chile

Jorge Gaete

[jgaete@uandes.cl](mailto:jgaete@uandes.cl)

Universidad de los Andes

Natalia Ríos

Universidad de los Andes

Saray Ramírez

Universidad de los Andes

Gabriel Salgado

Universidad de los Andes

Cristian A. Rojas-Barahona

Universidad de Talca

Ricardo Araya

King's College London

---

## Research Article

**Keywords:** Adolescents, Substance Abuse, Prevention, Acceptability, Feasibility, Fidelity

**Posted Date:** May 4th, 2026

**DOI:** <https://doi.org/10.21203/rs.3.rs-9296047/v1>

**License:**   This work is licensed under a Creative Commons Attribution 4.0 International License.  
[Read Full License](#)

**Additional Declarations:** No competing interests reported.

---

**Version of Record:** A version of this preprint was published at BMC Public Health on July 21st, 2026. See the published version at <https://doi.org/10.1186/s12889-026-28548-x>.



# Abstract

## Background

School-based preventive interventions for adolescent substance use often show limited short-term behavioral effects, with evidence suggesting that sustained impacts may depend on continued exposure and reinforcement strategies such as booster sessions. However, few studies have examined the longitudinal effects of booster implementation on substance use and related psychosocial outcomes in culturally adapted interventions.

## Methods

We conducted a cluster randomized controlled trial to evaluate the longitudinal impact of a culturally adapted school-based prevention program among adolescents in Chile, incorporating booster sessions following the core intervention. Students were assessed at baseline, post-intervention, and follow-up time points. The intervention included a structured curriculum targeting socio-emotional skills and substance use-related cognitions, followed by booster sessions designed to reinforce key components. Primary outcomes were substance use behaviors (30-day prevalence of tobacco, alcohol, and cannabis), while secondary outcomes included cognitive and psychosocial risk and protective factors. Mixed-effects models were used to assess changes over time, accounting for clustering at the school level.

## Results

A total of 765 students from 11 schools were enrolled, with 608 assessed at baseline and 538 at post-intervention. While no significant reductions in substance use were observed immediately post-intervention, longitudinal analyses indicated improvements in selected secondary outcomes, including more negative beliefs about tobacco and alcohol and enhanced decision-making processes. These changes were sustained and, in some cases, strengthened at follow-up assessments after the implementation of booster sessions. However, effects on behavioral outcomes remained limited across time points.

## Conclusions

Findings suggest that booster sessions may play a key role in consolidating changes in proximal cognitive and psychosocial mechanisms, even in the absence of immediate behavioral effects. The results highlight the importance of longitudinal follow-up in evaluating school-based prevention programs and support the inclusion of reinforcement components to enhance sustained impact. Future studies should further examine the dose–response relationship of booster sessions and their potential to translate intermediate changes into reductions in substance use.

## Trial registration

## INTRODUCTION

Substance use during early adolescence remains a major public health concern due to its short- and long-term consequences for neurodevelopment, mental health, and educational and social trajectories. Early initiation of alcohol, tobacco, and cannabis use has been associated with an increased risk of depression, anxiety, cognitive impairment, psychotic symptoms, suicidality, and the later development of substance use disorders (1–3). In Latin America, and particularly in Chile, substance use prevalence among school-aged adolescents remains high compared to other regions, underscoring the need for effective, scalable, and culturally appropriate prevention strategies (4, 5).

Schools constitute a key setting for universal substance use prevention during early adolescence, given their broad population reach and their central role in social, emotional, and cognitive development. Over the past decades, numerous school-based prevention programs have been developed and evaluated internationally, aiming to delay initiation and reduce escalation of substance use. Systematic reviews and meta-analyses consistently show that universal school-based programs produce small to moderate preventive effects, particularly for alcohol use, with more modest effects for tobacco and cannabis (6, 7). Importantly, programs grounded in cognitive-behavioral principles, social competence development, and skills training—such as self-regulation, problem-solving, and resistance to peer pressure—appear to be especially effective in early adolescence (6, 8).

Despite this evidence, several limitations persist in the prevention literature. First, average effects tend to attenuate over time, and many programs fail to demonstrate sustained impacts without continued reinforcement (7, 9). Second, relatively few studies include follow-up periods beyond 12–24 months, and robust evidence extending into later adolescence or early adulthood is largely restricted to a small number of trials conducted in high-income countries, such as Climate, Preventure, and related combined interventions (10–12). Third, there is a notable scarcity of rigorous longitudinal evaluations in Latin America, where most available studies remain pilot trials with short-term follow-up (13, 14).

Programs focused on social competence and life skills represent a particularly relevant approach for universal prevention in early adolescence. Interventions such as Life Skills Training, Unplugged, and the Social Competence Promotion Program for Young Adolescents (SCPP-YA) aim to reduce substance use indirectly by modifying key mediators, including beliefs about substances, perceived norms, refusal skills, emotional regulation, and problem-solving abilities (15–17). Evidence suggests that changes in these mediators often precede observable behavioral effects and may require time and repeated practice to translate into reductions in substance use (18, 19).

In Chile, Mi Mejor Plan (MMP) is a culturally adapted version of the SCPP-YA designed for implementation in the school context during early adolescence. A recently published cluster randomized pilot trial evaluated the acceptability, feasibility, fidelity, and immediate post-intervention outcomes of a

16-session adapted version of MMP delivered to sixth-grade students (14). The study demonstrated high levels of implementation quality and student acceptability, as well as significant improvements in specific protective factors, particularly increased negative beliefs about tobacco and alcohol use. However, no significant effects were observed on substance use prevalence immediately after the intervention, a finding consistent with international evidence indicating that behavioral effects may emerge later and depend on sustained exposure and reinforcement (6, 9).

Recent prevention research highlights the potential importance of booster sessions in maintaining and strengthening intervention effects over time. Booster sessions provide opportunities to rehearse previously learned skills, reinforce cognitive and behavioral strategies, and adapt prevention messages to adolescents' evolving developmental and social contexts (20). Studies with longer follow-up periods suggest that interventions incorporating reinforcement components are more likely to produce durable effects, particularly when they continue to target theoretically grounded mediators of substance use risk (10, 12). Nonetheless, empirical evidence examining the added value of booster sessions within universal, skills-based programs—especially in low- and middle-income countries—remains limited.

In this context, the present study represents a direct continuation of the previously published MMP pilot trial. Building on the initial post-intervention findings, this article aims to examine substance use outcomes and theoretically relevant mediating factors following the full implementation of *Mi Mejor Plan*, including both the original 16-session adapted curriculum and three booster sessions delivered during the subsequent academic year. By incorporating a longer follow-up period and focusing on changes in mediators alongside substance use outcomes, this study seeks to clarify whether early improvements in protective factors are sustained or amplified over time and whether the inclusion of booster sessions is associated with increased preventive impact. In doing so, the study addresses key gaps in the Latin American prevention literature and contributes to a more nuanced understanding of how culturally adapted, school-based prevention programs may influence adolescent substance use trajectories over time.

## Objectives

### General Objective

To evaluate the effects of the *Mi Mejor Plan* (MMP) school-based prevention program on substance use outcomes and theoretically relevant mediating factors among early adolescents, following the implementation of the adapted 16-session curriculum and three booster sessions delivered during the subsequent academic year.

### Specific Objectives

1. To examine changes in the prevalence and frequency of alcohol, tobacco, and cannabis use from baseline to follow-up after the completion of the full MMP intervention, including booster sessions.
2. To assess whether previously observed improvements in key protective factors—such as negative beliefs about substance use, risk perception, refusal skills, problem-solving abilities, emotion regulation, and sense of school membership—are sustained or enhanced at follow-up.
3. To evaluate changes over time in risk factors associated with substance use, including positive beliefs about substances, normative beliefs, and intentions for future use.

## METHODS

### Study Design

This study is a longitudinal follow-up of a cluster randomized controlled pilot trial evaluating the culturally adapted version of the *Social Competence Promotion Program for Young Adolescents (Mi Mejor Plan, MMP)*. The original trial assessed acceptability, feasibility, fidelity, and immediate post-intervention outcomes following the implementation of a 16-session school-based prevention program.

The present study extends the original evaluation by examining substance use outcomes and theoretically relevant mediating factors after the full implementation of the intervention, including three booster sessions delivered during the academic year following the initial intervention. Schools remained assigned to their original allocation (intervention or control), and outcomes were assessed using a repeated-measures design.

### Participants and Setting

Participants were students enrolled in sixth grade at the time of the original baseline assessment, attending primary schools located in the Metropolitan Region of Chile. Eligibility criteria for schools and students were identical to those used in the original trial and have been described in detail elsewhere (14). Briefly, eligible schools were mixed-sex primary schools with at least two sixth-grade classrooms and a high level of socioeconomic vulnerability, as defined by the School Vulnerability Index (IVE-SINAE).

All students who participated in the baseline and post-intervention assessments of the original trial were eligible for inclusion in the follow-up assessment. Written informed consent was obtained from parents or legal guardians, and written assent was obtained from students at each wave of data collection.

Further information about recruitment can be found in the previous report of this trial .

### Sample size

This follow-up study used the same sample derived from the pilot cluster randomized controlled trial previously reported. As described in the main trial publication (14), the sample size was determined

based on feasibility considerations rather than statistical power for effectiveness testing. No additional sample size calculations were performed for the 6-month follow-up. No interim analyses or stopping guidelines were prespecified.

## Randomisation

Details of the randomization procedure have been reported previously. In brief, schools were randomized at the cluster level (1:1 allocation to intervention or control) using a computer-generated sequence by an independent statistician. No additional randomization procedures were conducted for the follow-up phase.

## Blinding

As described in the primary trial report, blinding of participants, facilitators, and school personnel was not feasible due to the nature of the intervention. No additional blinding procedures were introduced for the follow-up assessments.

## Intervention

### Mi Mejor Plan (MMP)

The intervention consisted of a culturally adapted version of the *Social Competence Promotion Program for Young Adolescents* (SCPP-YA), implemented within regular school hours. As described in the original study, the adapted curriculum included 16 classroom-based sessions delivered over one academic year: 11 sessions focused on social problem-solving skills and 5 sessions focused on substance use prevention.

The core component of the program was a structured six-step social problem-solving model designed to enhance self-regulation, goal setting, cognitive flexibility, and decision-making. The substance use prevention module emphasized the application of these skills to high-risk situations, including peer pressure and normative influences related to alcohol, tobacco, and cannabis use. For more details, see the previous publication (14).

### Booster Sessions

In addition to the original 16 sessions, three booster sessions were delivered during the subsequent academic year. The booster sessions were designed to reinforce previously learned skills, provide additional opportunities for practice, and adapt prevention messages to students' developmental progression and emerging social challenges. Content focused on revisiting the problem-solving steps, strengthening refusal skills, and reinforcing negative beliefs and risk perception related to substance use. See Suppl. 1 for content details of booster sessions.

Booster sessions were delivered by trained facilitators, following a standardized manual developed by the research team, and were implemented during regular school hours.

## Control Condition

Schools assigned to the control group continued to receive treatment-as-usual (TAU), consisting of the standard non-manualized prevention content delivered during the “Orientation” class, as defined by national educational guidelines. The research team did not interfere with or standardize the content delivered in control schools.

## Measures

### Substance Use Outcomes

Substance use outcomes were assessed using the *European Drug Addiction Prevention Trial Questionnaire* (EU-Dap), a self-report instrument validated for use in Chilean adolescents (21). Outcomes included 30-day prevalence of tobacco, alcohol, and cannabis use, and drunkenness. Binary indicators were created for each substance based on standard EU-Dap scoring procedures.

### Risk and Protective Factors

The following theoretically relevant risk and protective factors were assessed, consistent with the theory of change of the MMP program:

1. **Beliefs about substance use.** Beliefs about substance use were assessed using subscales from the European Drug Addiction Prevention Trial Questionnaire (EU-Dap) (21). These scales evaluate adolescents’ cognitive expectations regarding the potential benefits and harms associated with the use of specific substances, including tobacco, alcohol, and cannabis. For each substance, the instrument distinguishes between positive beliefs, reflecting perceived benefits or desirable effects of use (e.g., social acceptance or emotional relief), and negative beliefs, reflecting perceived risks or adverse consequences associated with consumption. Items are rated on Likert-type scales, with higher scores indicating stronger endorsement of the respective belief dimension. These belief constructs are theoretically grounded in social-cognitive models of substance use (18), where outcome expectations play a central role in shaping adolescents’ decisions to initiate or avoid substance use. The EU-Dap questionnaire has been culturally adapted and validated for use among Chilean early adolescents, demonstrating adequate factorial validity and internal consistency for the belief subscales evaluating tobacco, alcohol, and marijuana use (21).
2. **Normative beliefs and future substance use intentions.** Perceived social norms regarding substance use and intentions for future use were also assessed using EU-Dap items. Normative beliefs capture adolescents’ perceptions of how common substance use is among their peers, including both close friends and adolescents of similar age. These perceptions reflect the degree to which substance use is viewed as socially normative within the adolescent’s peer context. The future substance use intentions scale evaluates the likelihood that adolescents believe they may

use substances in the future. This construct captures behavioural expectations that may precede the initiation of substance use. Both constructs are widely recognised predictors of substance use initiation during adolescence. Research has shown that misperceptions of peer norms are strongly associated with increased substance use, as adolescents often overestimate the prevalence of use among peers (22). In the Chilean validation study of the EU-Dap questionnaire, the normative beliefs and future substance use subscales demonstrated acceptable psychometric properties and meaningful associations with recent substance use behaviours, supporting their relevance as risk indicators and potential mediators of preventive interventions (21).

3. **Risk perception and refusal skills.** Risk perception and refusal skills related to substance use were measured using EU-Dap subscales (21). The risk perception scale assesses adolescents' perceptions of the potential negative consequences of substance use, including health, psychological, and social harms. Higher scores indicate greater perceived risk associated with engaging in behaviours such as smoking, drinking alcohol, or using marijuana. The refusal skills scale evaluates adolescents' perceived ability to resist peer pressure and decline offers to use substances. These items reflect behavioural competence and assertiveness in situations where substances may be offered by peers. Both constructs represent key protective factors targeted by many school-based prevention programs. Evidence from the Chilean validation of the EU-Dap questionnaire indicates that higher perceived risk and stronger refusal skills have been linked to lower odds of recent substance use, supporting their role as important intermediate outcomes in prevention research (21).
4. **Social problem-solving skills.** Adolescents' problem-solving abilities were measured using the Social Problem-Solving Inventory – Revised Short Form (SPSI-R:S), a widely used instrument designed to assess cognitive-behavioural processes involved in identifying, evaluating, and responding to everyday problems (23). The SPSI-R:S has 25 items and conceptualizes social problem solving as a multidimensional construct that includes both individuals' orientation toward problems and the strategies they use to address them. The instrument captures key aspects of problem-solving competence, including constructive approaches to problem resolution as well as more maladaptive or impulsive response patterns. Participants respond to items using Likert-type scales reflecting how typical each statement is of their usual behaviour. Higher scores indicate more adaptive problem-solving abilities. Social problem-solving skills are considered an important psychosocial competence during adolescence and have been associated with better coping, lower emotional distress, and reduced engagement in health-risk behaviours (23).
5. **Emotion regulation.** Emotion regulation strategies were assessed using the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA), a developmentally adapted version of the original Emotion Regulation Questionnaire designed to evaluate how young people manage their emotional responses (24, 25). The instrument has 10 items and assesses two widely studied regulatory strategies: cognitive reappraisal (6 items) and expressive suppression (4 items). Cognitive reappraisal refers to the tendency to reinterpret emotionally evocative situations in order to modify their emotional impact, whereas expressive suppression reflects the inhibition of emotional expression after an emotional response has been generated. Participants rate items on a

Likert-type scale indicating how frequently they use each strategy in everyday situations. Higher scores in the cognitive reappraisal subscale indicate greater emotion regulation. On the contrary, a higher score in expressive suppression indicated lower emotion regulation. This questionnaire has been validated among adolescents in Chile, showing good psychometric properties (26).

6. **Psychological sense of school membership.** Students' sense of belonging within the school environment was assessed using the Psychological Sense of School Membership (PSSM) scale, a 18-item questionnaire developed to measure adolescents' perceptions of acceptance, inclusion, and support within their school community (27). The PSSM evaluates the extent to which students feel respected and valued by teachers and peers, as well as their overall sense of belonging and emotional connection to the school. Participants indicate their level of agreement with statements reflecting feelings of inclusion, support, and recognition within the school context. Higher scores indicate a stronger sense of school membership. A robust body of research has shown that school belonging is a key protective factor during adolescence and is associated with improved academic engagement, psychological wellbeing, and lower levels of risk behaviours, including substance use (27). The validation in Chile includes 13 of the 18 original items, demonstrating unidimensionality and good psychometric properties (28).

## Data Collection Procedures

Assessments were conducted at three time points: 1) baseline (prior to intervention), 2) immediate post-intervention (after the 16-session curriculum), and 3) follow-up assessment after completion of the three booster sessions. Questionnaires were administered in classroom settings by trained research assistants using standardized procedures. Confidentiality was ensured by using anonymized participant codes.

## Statistical Analysis

The analytical approach for the follow-up outcomes was consistent with that used in the primary analysis. All analyses followed an intention-to-treat framework, whereby participants were analyzed according to their original allocation.

Mixed-effects models were used to examine changes over time and between-group differences at follow-up, accounting for the clustered structure of the data (students nested within schools) and repeated measures within participants. Models included fixed effects for group, time, and baseline values of the outcome, with additional adjustment for age and sex in fully adjusted models. Random effects for school and participant were included.

Binary outcomes were analyzed using logistic mixed-effects models and are reported as odds ratios with 95% confidence intervals. Continuous outcomes were analyzed using linear mixed-effects models and are reported as adjusted mean differences with 95% confidence intervals and standardized effect sizes.

Analyses were conducted using all available data within the mixed-effects framework. No additional procedures for handling missing data (e.g., multiple imputation) were implemented. Attrition and response rates at follow-up are reported to characterize data completeness.

No subgroup or sensitivity analyses were conducted.

The trial protocol is available at ClinicalTrials.gov (NCT04236947). Additional methodological details are reported in the original trial publications (14, 29).

## Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Ethics Committee of Universidad de los Andes (CEC201983). Participation was voluntary, and students and caregivers were informed of their right to withdraw at any time without consequences.

## Harms

As in the primary trial report, harms were not specified as a formal outcome, and no systematic adverse event monitoring protocol was implemented. During the follow-up period, no intervention-related harms were reported.

## RESULTS

### Participant Flow and Follow-up Rates

A total of 575 schools were assessed for eligibility; 95 were excluded and 315 were not invited after reaching the required sample size. Of the 165 schools invited, 12 were randomized (6 intervention, 6 control). Following allocation, 11 schools (765 students) were included in the study: 5 schools (n=344 students) in the intervention arm and 6 schools (n=421 students) in the control arm. At baseline, 647 students were assessed (intervention: n=302; control: n=345). At post-intervention, 499 students were assessed (intervention: n=236; control: n=263), corresponding to a retention rate of 77.1%. At follow-up, 426 students were assessed (intervention: n=198; control: n=228), corresponding to an overall retention rate of 65.8% from baseline. Attrition across assessment points was primarily due to student absence, lack of consent or assent, and non-response. See Figure 1.

INSERT FIGURE 1.

### Baseline Characteristics

Baseline characteristics of participants are presented in Table 1. A total of 608 students were included at baseline (intervention: n=263; control: n=345). The mean age was 11.3 years in both groups (SD=0.6 and 0.5, respectively), and the proportion of females was identical across groups (47.5%).

In the intervention group, 68.8% of students attended subsidized schools and 31.2% attended public schools, whereas all students in the control group were from subsidized schools. The mean School

Vulnerability Index (IVE-SINAE) was similar between groups (intervention: 77.8 [SD=12.4]; control: 78.4 [SD=7.5]).

The prevalence of substance use in the past 30 days was low in both groups, including tobacco (1.9% vs. 1.2%), alcohol (6.8% vs. 5.2%), drunkenness (1.1% vs. 0.6%), and marijuana (1.1% vs. 0.0%) in the intervention and control groups, respectively.

Mean scores for EU-Dap risk and protective factors, emotion regulation (ERQ-CA), social problem-solving (SPSI-RS), and school belonging (PSSM) were comparable between groups at baseline.

INSERT TABLE 1

**Substance Use Outcomes at Follow-up**

Thirty-day prevalence of substance use and intervention effects at post-intervention and 6-month follow-up are presented in Table 2.

At post-intervention, the prevalence of tobacco, alcohol, drunkenness, and marijuana use remained low in both groups. The estimated intervention effects showed no statistically significant differences between groups for any substance, including tobacco (OR=1.04, 95% CI 0.14–7.44), alcohol (OR=1.51, 95% CI 0.50–4.58), drunkenness (OR=1.01, 95% CI 0.08–12.59), and marijuana (OR=2.38, 95% CI 0.17–32.51).

At 6-month follow-up, prevalence estimates remained low across both groups. No statistically significant intervention effects were observed for tobacco (OR=0.26, 95% CI 0.03–2.02), alcohol (OR=0.66, 95% CI 0.18–2.41), or drunkenness (OR=0.59, 95% CI 0.03–10.27).

For marijuana use at follow-up, the mixed-effects logistic regression model could not be estimated due to the insufficient number of events. This likely reflects the very low prevalence of marijuana use in the sample, which can lead to sparse data and quasi-complete separation, limiting the stability and convergence of logistic mixed-effects models.

INSERT TABLE 2.

**Changes in Risk and Protective Factors**

Changes in risk and protective factors at post-intervention and 6-month follow-up are presented in Table 3.

At post-intervention, statistically significant differences were observed in several protective factors. The intervention group showed higher scores in negative beliefs about tobacco (aMD=1.11, 95% CI 0.47–1.75), alcohol (aMD=1.33, 95% CI 0.46–2.21), and marijuana (aMD=1.36, 95% CI 0.32–2.39). No significant differences were found for risk perception, refusal skills, normative beliefs, or future substance use.

At 6-month follow-up, significant differences were observed in both risk and protective factors. The intervention group showed lower normative beliefs regarding friends (aMD=-0.50, 95% CI -0.79 to -0.20) and other adolescents (aMD=-0.87, 95% CI -1.58 to -0.16), as well as lower future substance use intentions (aMD=-0.92, 95% CI -1.57 to -0.27). In addition, higher scores were observed in negative beliefs about tobacco (aMD=0.75, 95% CI 0.01-1.39).

An increase in positive beliefs about marijuana was also observed at follow-up (aMD=0.86, 95% CI 0.09-1.64). No statistically significant differences were found for emotion regulation (ERQ-CA), social problem-solving skills (SPSI-RS), or school belonging (PSSM) at either time point.

INSERT TABLE 3.

## DISCUSSION

This study evaluated the 6-month follow-up effects of the Mi Mejor Plan school-based intervention on substance use and associated risk and protective factors among early adolescents. Overall, no statistically significant effects were observed on 30-day substance use outcomes. However, the intervention was associated with meaningful changes in several proximal cognitive and social determinants of substance use. At follow-up, students in the intervention group reported lower normative beliefs and future substance use intentions, as well as higher negative beliefs about tobacco. At the same time, an increase in positive beliefs about marijuana was observed. No effects were found for emotion regulation, social problem-solving skills, or school belonging.

The absence of significant effects on substance use outcomes is consistent with previous research on universal school-based prevention programs delivered in early adolescence, where behavioural effects are often modest or delayed (30). Systematic reviews and meta-analyses have shown that prevention effects on actual substance use tend to emerge over longer follow-up periods, particularly as exposure and opportunity to use substances increase with age (30).

Importantly, the observed changes in normative beliefs and future substance use intentions are aligned with the theoretical mechanisms targeted by evidence-based prevention programs such as Unplugged and other EU-Dap-based interventions. Normative beliefs, in particular, have been identified as one of the most robust predictors of adolescent substance use across substances (31), and prior research has demonstrated that modifying perceived peer norms is a key pathway through which school-based interventions exert their effects (13, 32).

These findings are also broadly consistent with the post-intervention results reported in the first phase of this study, where early changes were observed in several cognitive determinants but not in behavioural outcomes (14). The persistence—and in some cases strengthening—of effects on normative beliefs and future intentions at follow-up suggests that these cognitive shifts may be sustained over time, even in the absence of immediate behavioural changes.

More broadly, these results are in line with the prevention literature indicating that universal school-based interventions tend to have stronger effects on intermediate outcomes (e.g., beliefs, intentions, skills) than on substance use behaviour itself, particularly in younger samples with low baseline prevalence (6, 7).

Several factors may explain the pattern of results observed in this study. First, the low prevalence of substance use at baseline and follow-up likely limited the ability to detect behavioural effects. Early adolescence represents a developmental stage where substance use initiation is still relatively infrequent, and prevention efforts may primarily operate by shaping attitudes, norms, and intentions before behavioural patterns are established (8). Second, the observed reductions in normative beliefs and future substance use intentions suggest that the intervention may be influencing key upstream mechanisms of risk. These constructs are central components of social influence models, and their modification has been linked to later reductions in substance use in longer-term follow-up studies (33). Third, the increase in positive beliefs about marijuana represents an unexpected finding. One possible explanation is that increased exposure to substance-related content during the intervention may have enhanced cognitive salience, including awareness of perceived short-term or socially mediated positive effects (34). This phenomenon has been described in previous prevention research, where increased knowledge does not uniformly translate into less favourable attitudes across all domains (34). Additionally, broader sociocultural trends toward the normalization of cannabis use may have influenced adolescents' perceptions independently of the intervention (35–37). Fourth, the absence of effects on emotion regulation, problem-solving, and school belonging may reflect the fact that these domains were not the primary targets of the intervention, or that changes in these broader psychosocial constructs require more intensive or longer-term intervention components to be detectable (38, 39).

Several limitations should be considered when interpreting these findings. First, the relatively low prevalence of substance use in the sample limited statistical power to detect intervention effects on behavioural outcomes and contributed to analytical challenges, including the inability to estimate some models due to sparse data. Second, attrition over time may have introduced bias, although retention rates were within the expected range for school-based longitudinal studies. Third, the study relied on self-reported measures, which may be subject to reporting bias, particularly for sensitive behaviours such as substance use. Fourth, differences in school characteristics between groups—such as school type—may have introduced residual confounding despite statistical adjustment. Finally, the follow-up period may have been insufficient to capture longer-term behavioural effects, which are often delayed in prevention research.

Future research should examine the longer-term effects of the Mi Mejor Plan intervention, particularly as participants transition into later adolescence, when substance use becomes more prevalent. Extending follow-up periods may help determine whether early changes in cognitive and social determinants translate into meaningful reductions in substance use over time.

Additionally, intervention refinements may be warranted to more directly address substance-specific beliefs, particularly regarding marijuana, given the observed increase in positive beliefs. Strengthening components targeting social norms and perceived benefits of use may enhance program effectiveness in this domain.

Further research could also explore the integration of complementary components targeting emotional regulation and coping skills, as combined prevention approaches addressing both substance use and mental health have shown promise in recent studies (9, 11). Finally, future studies should consider larger samples or higher-risk populations to improve the ability to detect behavioural effects and to better understand for whom and under what conditions the intervention is most effective.

## **Declarations**

### **Ethics approval and consent to participate**

All procedures performed in this study were reviewed and approved by the Ethics Committee of Universidad de los Andes, Chile (protocol number: (CEC 201983, November 5 th, 2019)). The study was conducted in accordance with the Declaration of Helsinki and local regulations. Written informed consent was obtained from parents or legal guardians, and assent was obtained from all participating students prior to enrolment.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets generated and/or analyzed during the current study are not publicly available due to ethical and data protection restrictions but are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

This research was funded by the National Research and Development Agency [ANID]. Unique ID: FONIS SA19I0115. The funding body had no role in the design of the study; collection, analysis, and interpretation of data; or in writing the manuscript.

## Authors' contributions

JG, CRB and RZ conceptualised the study and secured funding. NR and SR contributed to study design and implementation. JG and GS conducted the statistical analyses. SR and NR contributed to data collection and management. JG drafted the manuscript, and all authors critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

## Acknowledgements

The authors would like to thank the participating schools, students, teachers, and facilitators for their collaboration in this study.

## References

1. Erskine HE, Moffitt TE, Copeland WE, Costello EJ, Ferrari AJ, Patton G, et al. A heavy burden on young minds: the global burden of mental and substance use disorders in children and youth. *Psychol Med*. 2015;45(7):1551–63.
2. Thorpe HHA, Hamidullah S, Jenkins BW, Khokhar JY. Adolescent neurodevelopment and substance use: Receptor expression and behavioral consequences. *Pharmacol Ther*. 2020;206:107431.
3. Rioux C, Huet A-S, Castellanos-Ryan N, Fortier L, Le Blanc M, Hamaoui S, et al. Substance use disorders and suicidality in youth: A systematic review and meta-analysis with a focus on the direction of the association. *PLoS ONE*. 2021;16(8):e0255799.
4. Observatorio Chileno de Drogas. Medio. Santiago, Chile: Servicio Nacional para la Prevención y Rehabilitación del Consumo de Drogas y Alcohol (SENDA). Ministerio del Interior y Seguridad Pública; 2023. Décimo Cuarto Estudio Nacional de Drogas en Población Escolar de Chile 2021 8º Básico a 4º.
5. Hynes M, Clarke P, Cumsille F, Araneda-Ferrer J, Ahumada G. Informe sobre el consumo de drogas en las Américas 2019. Washington DC: Organización de los Estados Americanos; 2019.
6. Onrust SA, Otten R, Lammers J, Smit F. School-based programmes to reduce and prevent substance use in different age groups: What works for whom? Systematic review and meta-regression analysis. *Clin Psychol Rev*. 2016;44:45–59.
7. Das JK, Salam RA, Arshad A, Finkelstein Y, Bhutta ZA. Interventions for adolescent substance abuse: An overview of systematic reviews. *J Adolesc Health*. 2016;59(4):S61–75.
8. Gray KM, Squeglia LM. Research Review: What have we learned about adolescent substance use? *J Child Psychol Psychiatry*. 2018;59(6):618–27.
9. Teesson M, Birrell L, Slade T, Mewton LR, Olsen N, Hides L, et al. Effectiveness of a universal, school-based, online programme for the prevention of anxiety, depression, and substance misuse among adolescents in Australia: 72-month outcomes from a cluster-randomised controlled trial. *Lancet Digit Health*. 2024;6(5):e334–44.

10. Newton NC, Stapinski LA, Slade T, Sunderland M, Barrett EL, Champion KE, et al. The 7-year effectiveness of school-based alcohol use prevention from adolescence to early adulthood: a randomized controlled trial of universal, selective, and combined interventions. *J Am Acad Child Adolesc Psychiatry*. 2022;61(4):520–32.
11. Slade T, Newton NC, Mather M, Barrett EL, Champion KE, Stapinski L, et al. The long-term effectiveness of universal, selective and combined prevention for alcohol use during adolescence: 36-month outcomes from a cluster randomized controlled trial. *Addiction*. 2021;116(3):514–24.
12. Conrod P, Stewart SH, Seguin J, Pihl R, Masse B, Spinney S, et al. Five-year outcomes of a school-based personality-focused prevention program on adolescent substance use disorder: a cluster randomized trial. *Am J Psychiatry*. 2025;182(5):473–82.
13. Salgado G, Gaete J, Gana S, Valenzuela D, Araya R. Acceptability, feasibility and fidelity of the culturally adapted version of Unplugged (Yo Se Lo Que Quiero), a substance use preventive program among adolescents in Chile: a pilot randomized controlled study. *BMC Public Health*. 2024;24(1):2026.
14. Ramirez S, Ríos N, Rojas-Barahona CA, Cárcamo M, Sepulveda-Pañaloza A, Araya R, et al. Acceptability, feasibility, fidelity and quality implementation of the culturally adapted version of the Social Competence Promotion Program among Young Adolescents (Mi Mejor Plan) to prevent substance use among adolescents in Chile: a pilot randomized control study. *BMC Public Health*. 2025;25(1):1860.
15. Botvin GJ, Griffin KW. Life skills training as a primary prevention approach for adolescent drug abuse and other problem behaviors. *Int J Emerg Ment Health*. 2002;4(1):41–7.
16. Faggiano F, Galanti MR, Bohrn K, Burkhart G, Vigna-Taglianti F, Cuomo L, et al. The effectiveness of a school-based substance abuse prevention program: EU-Dap cluster randomised controlled trial. *Prev Med*. 2008;47(5):537–43.
17. Caplan M, Weissberg RP, Grober JS, Sivo PJ, Grady K, Jacoby C. Social competence promotion with inner-city and suburban young adolescents: effects on social adjustment and alcohol use. *J Consult Clin Psychol*. 1992;60(1):56–63.
18. Giannotta F, Vigna-Taglianti F, Rosaria Galanti M, Scatigna M, Faggiano F. Short-term mediating factors of a school-based intervention to prevent youth substance use in Europe. *J Adolesc Health*. 2014;54(5):565–73.
19. Vigna-Taglianti F, Mehanović E, Alesina M, Damjanović L, Ibanga A, Pwajok J, et al. Effects of the Unplugged school-based substance use prevention program in Nigeria: A cluster randomized controlled trial. *Drug Alcohol Depend*. 2021;228:108966.
20. Darling-Hammond L, Flook L, Cook-Harvey C, Barron B, Osher D. Implications for educational practice of the science of learning and development. *Appl Dev Sci*. 2020;24(2):97–140.
21. Ramirez S, Gana S, Godoy MI, Valenzuela D, Araya R, Gaete J. Validation of the European Drug Addiction Prevention Trial Questionnaire (EU-Dap) for substance use screening and to assess risk and protective factors among early adolescents in Chile. *PLoS ONE*. 2021;16(10):e0258288.

22. Watts LL, Hamza EA, Bedewy DA, Moustafa AA. A meta-analysis study on peer influence and adolescent substance use. *Curr Psychol*. 2024;43(5):3866–81.
23. D’Zurilla TJ, Nezu AM, Maydeu-Olivares A. Social Problem-Solving Inventory-Revised (SPSI-R): Technical manual. Multi-Health Systems; 2002.
24. Gross JJ. Emotion regulation: conceptual and empirical foundations. 2014.
25. Gullone E, Taffe J. The Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA): a psychometric evaluation. *Psychol Assess*. 2012;24(2):409–17.
26. Villacura-Herrera C, Gaete J, Andaur J, Meza D, Robinson J, Núñez D. Evidence for validity, reliability and measurement invariance of the emotion regulation questionnaire for children and adolescents (ERQ-CA) in secondary students from Chile. *Curr Psychol*. 2023;42(31):27771–82.
27. Goodenow C. The psychological sense of school membership among adolescents: Scale development and educational correlates. *Psychol Sch*. 1993;30(1):79–90.
28. Gaete J, Montero-Marin J, Rojas-Barahona CA, Olivares E, Araya R. Validation of the Spanish Version of the Psychological Sense of School Membership (PSSM) Scale in Chilean Adolescents and Its Association with School-Related Outcomes and Substance Use. *Front Psychol*. 2016;7:1901.
29. Gaete J, Inzunza C, Ramirez S, Valenzuela D, Rojas C, Araya R. The Social Competence Promotion Program among Young Adolescents (SCPP-YA) in Chile (Mi Mejor Plan) for substance use prevention among early adolescents: study protocol for a randomized controlled trial. *Trials*. 2022;23(1):542.
30. Foxcroft DR, Tsertsvadze A. Universal school-based prevention programs for alcohol misuse in young people. *Cochrane Database Syst Rev*. 2011(5):Cd009113.
31. Faggiano F, Vigna-Taglianti F, Burkhart G, Bohrn K, Cuomo L, Gregori D, et al. The effectiveness of a school-based substance abuse prevention program: 18-month follow-up of the EU-Dap cluster randomized controlled trial. *Drug Alcohol Depend*. 2010;108(1–2):56–64.
32. Giannotta F, Vigna-Taglianti F, Rosaria Galanti M, Scatigna M, Faggiano F. Short-Term Mediating Factors of a School-Based Intervention to Prevent Youth Substance Use in Europe. *J Adolesc Health*. 2014;54(5):565–73.
33. Webb TL, Sheeran P. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull*. 2006;132(2):249–68.
34. Werch CE, Owen DM. Iatrogenic effects of alcohol and drug prevention programs. *J Stud Alcohol*. 2002;63(5):581–90.
35. Bhangu GK, Singh A, Shah A, Malhi N. Cannabis Use in Adolescents. *Dela J Public Health*. 2025;11(3):6–13.
36. Hasin DS. US Epidemiology of Cannabis Use and Associated Problems. *Neuropsychopharmacology*. 2018;43(1):195–212.
37. Blevins CE, Marsh E, Banes KE, Stephens RS, Walker DD, Roffman RA. The Implications of Cannabis Policy Changes in Washington on Adolescent Perception of Risk, Norms, Attitudes, and Substance

Use. Subst Abuse: Res Treat. 2018;12:1178221818815491.

38. Eadeh HM, Breau R, Nikolas MA. A Meta-Analytic Review of Emotion Regulation Focused Psychosocial Interventions for Adolescents. Clin Child Fam Psychol Rev. 2021;24(4):684–706.
39. Pedrini L, Meloni S, Lanfredi M, Rossi R. School-based interventions to improve emotional regulation skills in adolescent students: A systematic review. J Adolesc. 2022;94(8):1051–67.

## Tables

Tables 1 to 3 are available in the Supplementary Files section.

## Figures

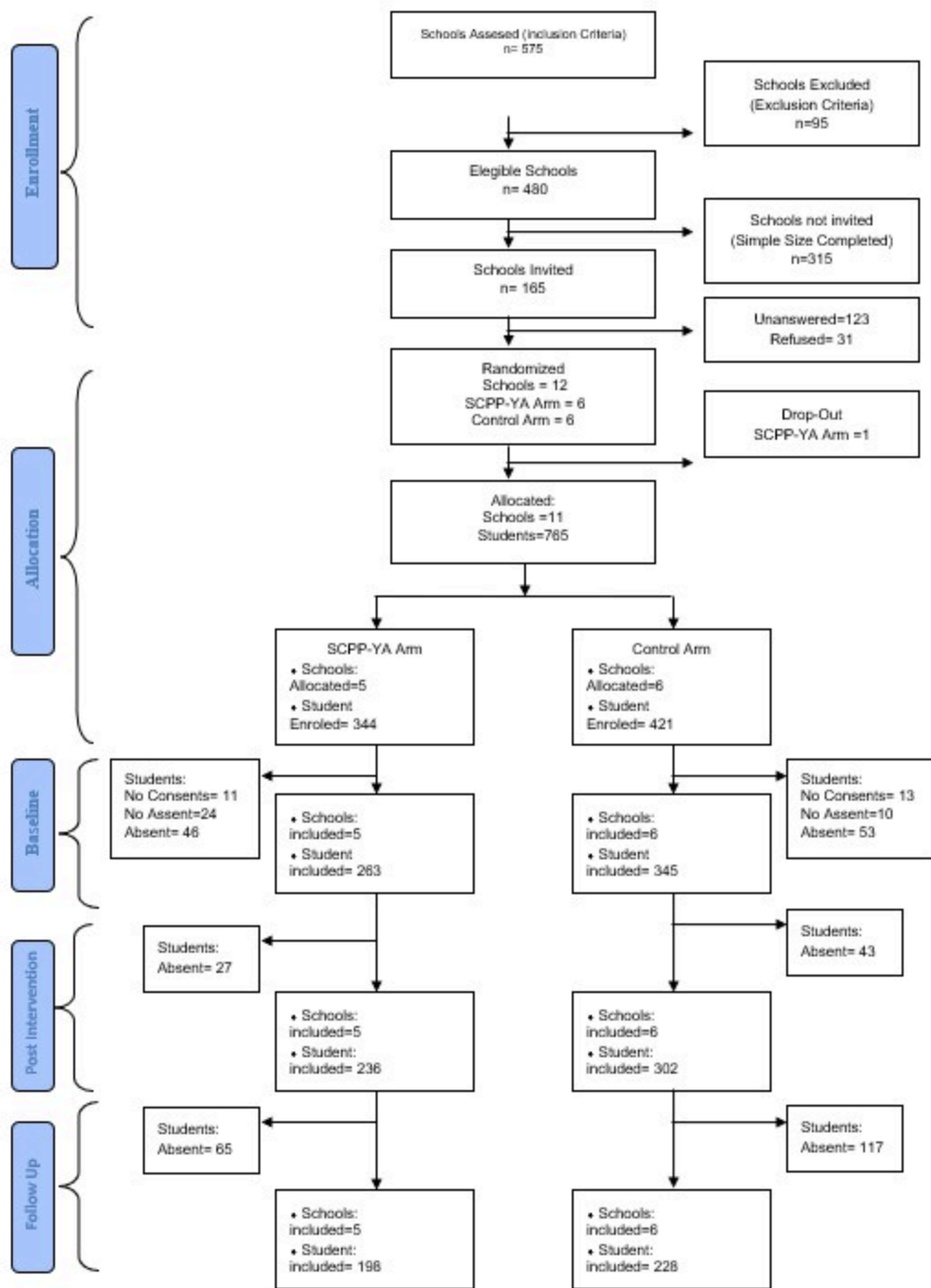


Figure 1

## CONSORT 2010 Flow Diagram

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1baseline.docx](#)

- [Table2impacts substance use.docx](#)
- [Table3risk protective factors.docx](#)
- [Suppl1 Boostersessions.docx](#)